FOODS AND SANITATION

FOODS AND SANITATION

A TEXT-BOOK AND LABORATORY MANUAL FOR HIGH SCHOOLS

BY

EDITH HALL FORSTER, B.A.

FORMERLY DIRECTOR OF HOME ECONOMICS, NORTHERN ILLINOIS STATE NORMAL SCHOOL, DEKALB, ILLINOIS

AND

MILDRED WEIGLEY

DIRECTOR OF HOME ECONOMICS, NORTHERN ILLINOIS STATE NORMAL SCHOOL, FORMERLY TEACHER OF DOMESTIC SCIENCE, TOWNSHIP HIGH SCHOOL, DEKALB, ILLINOIS

CHICAGO NEW YORK

ROW, PETERSON AND COMPANY

PREFACE

This book is the result of many requests for the laboratory manuals used by the writers in their high school work. The experiments have been used in a progressive high school where no special preparation has been required of the pupils before undertaking the work. The text has been drawn from sources too technical or scattered for high school pupils and modified for them.

I. The Aim. It is planned, by experiments and many applications, to give an understanding of the scientific principles underlying:

1. The economical use of fuel.
2. The processes of sterilization and food preparation.
3. The choosing of food in regard to its composition and condition.
4. The selection of food for the normal body.
5. Important conditions of home sanitation.

II. The Method. It is hoped the method is such that the pupil will get principles rather than isolated facts; that she may be able, with these principles, to make independently many more applications than are given in the book. It is hoped, above all things, to stimulate thought rather than imitation. Instead of one recipe, various proportions and conditions have been given to gain a greater comprehension of the effect of different ingredients and conditions, and so to achieve greater mastery. With a little experience the pupil can make adjustments to material, economy, and particular desire.

A subject is taken up in the following order:

1. Discussion to connect with the pupil's previous experience, to get a purpose for the new subject. In other words, a psychological approach is used.

2. General discussion giving information not to be derived from the pupil's experiments.

3. Simple experiments to discover the principles underlying the subject.

4. Applications to the preparation of food of information and of conclusions from experiments.

III. The Order. To introduce the entire subject a survey of the use of food by the body is given. The use of fuels and utensils as the tools, and of the different methods of conveying heat, must naturally precede all cooking. The cooking and canning of fruits follows because of the season (work generally begun in the Fall), and because of the simplicity of composition and preparation. The work on bacteriology and canning may be omitted if desired. Similarity of composition and increasing difficulty of preparation determine the order from this point on.

IV. Requirements of Pupil and Equipment:

1. Work in cooking in an elementary school is not presupposed, but should this have been had, the greater compass and different point of view will maintain interest even where there is repetition.

2. It is supposed that the pupil has had some work on the physiology of digestion, such as would be secured in the physiology required in the elementary school or in the first year of the high school, but no other science work is assumed.

3. In addition to the ordinary laboratory utensils, test tubes and a few very easily procured chemicals are used. It is highly desirable to have a number of chemical ther-

mometers, but in case only one can be had, experiments requiring the use of a thermometer may be performed by a group of students.

V. The Results Which it is Hoped may be Attained Are:

1. That the girl who has no more than high school training will have acquired sufficient knowledge to give her a scientific attitude toward the household affairs with which this book deals.

2. That she may perform her duties as housekeeper, whether of actual work or supervision, with more intelligence, greater interest, less labor, and better health and happiness to herself and family.

The subject of Household Sanitation has been added after requests to have both that and Foods treated of in one book. The aim in this section has been to carry out the applied bacteriology of the Food section in the care of the person and of the house, and to bring to the notice of the High School pupil some of the important factors in physical comfort.

The authors wish to acknowledge their indebtedness to Miss Marion Talbot of the University of Chicago and Mrs. Alice Peloubet Norton for their criticisms and helpful suggestions; to Mr. F. M. Giles of the DeKalb Township High School for valuable suggestions from the point of view of high school work; to Miss Anne Green for helpful criticism after using the manuscript in her classes; to Miss Barbara Patten for her suggestions and her assistance in securing pictures and in preparing the index; also to the University of Illinois for the use of pictures. For the chapter on Fire Prevention in the Home they are indebted to Mr. H. Walter Forster.

NOTE TO TEACHERS

It is not the thought of the authors that the order of subjects in this book must have close adherence. The order may be altered according to the necessities of the school and community. For example, the chapter on *Ices and Ice Creams* is placed toward the beginning, when the subject of temperature is being studied, but there is no reason why it might not be put in at the end, if desired.

Since this book is not designed to be a cook book, the teacher should see that the student keeps a careful record of good proportions and recipes which come as a result of an experiment or a series of experiments.

It will be noted that while most of the book is written without Physics and Chemistry as a prerequisite, occasionally some work, as in the case of baking powders, has been added to be used by high school students who have had some work in Chemistry. This may be omitted at the discretion of the teacher without altering the general plan of the book. Realizing that many of the books on food are too technical to be used for reference work by high school students, an effort has been made to give references to easily available bulletins. In some cases, references to bulletins of use only to teachers have been given. In these instances a note "for teachers" is inserted after the reference.

The authors are very desirous of making this book a workable laboratory manual, and to this end will welcome at any time any suggestions and criticisms.

CONTENTS

SANITATION

FOODS AND SANITATION

CHAPTER I

FOOD MEASUREMENTS AND WEIGHTS

The Study of Food. The body is a delicately adjusted mechanism which derives from the food which it consumes, not only the material for its growth and renewal, but also all its ability to produce work and heat. Although delicately adjusted, the machine will work under adverse conditions, though the ease and quality of its work is impaired.

In order to keep the body working efficiently, the proper kinds and quantities of foods must be provided. The application of science to human nutrition, or the proper feeding of mankind, has only been begun. The science of feeding some of the lower animals has progressed further and shows marvelous results in improvement in health, size, and efficiency, and therefore in money value. The application of bacteriology and sanitation has prolonged the average of human life. This has been brought about largely by cleaner water, milk, vegetables, meat, etc.; by better care of the sick, by better housing, by the abandonment of the public

drinking cup and other sources of infection. With this longer life, we should have a smaller percentage of days of inefficiency, less headache, weariness, and all that host of things which keep people from feeling buoyant as they should when in good health. As the science of nutrition develops it shows more and more how the kind, the quantity, the cooking, and the eating of food affects these conditions of life.

Foods are materials which contain any or all of five different classes of substances in a form which the body can use. These are called nutrients. They perform different kinds of work for the body as the following table shows:

1. *Protein.* Examples: The curd of milk, the lean of meat. Protein builds and repairs tissue, and also furnishes heat and power to do work.

2. *Carbohydrates.* Examples: Starch, sugar, glucose. Carbohydrates furnish heat and power to do work.

3. *Fats.* Examples: Olive oil, lard, cottolene, butter. Fats have the same functions as carbohydrates.

4. *Ash.* Example: Common salt, iron, lime, and sulphur. Ash is a necessary constituent of all of the fluids of the body, as well as of the cells, the bones, the hair, and the teeth. When foods are burned, just as when coal or wood is burned, the mineral material which they contain is left, and this is called ash.

5. *Water.* Water is necessary to make the fluids, the blood, lymph, and digestive juices.

Spices and other flavoring materials, although they contain a little ash and protein and sometimes

starch, are not considered foods on account of the minute quantities used. Meat extracts are not foods, neither are tea and coffee. They contain either no nutrients, or nutrients in such a form that the body can not use them. They are stimulants and helpful in time of great fatigue, but they must not be considered nourishment.

The body needs the greatest amount of food as fuel for heat and work. All during life the muscles of the body are contracting and expanding, performing different amounts of work, from that of breathing in sleep to that of the hardest physical or mental labor. Every kind of work done results also in heat, the amount depending upon the amount of work done. We know that in winter we may make ourselves warm by moving about, or by working. And we feel hotter in summer according as the activity of work increases.

After many experiments it has been found that work equal to lifting 427 kilograms, or 939.4 pounds, the distance of 1 meter is capable of producing the amount of heat which would raise the temperature of one kilogram or about 1 quart of water 1° C. This amount of heat is called a calorie, which is a unit used in measuring heat, as an inch is the unit for measuring length. The amount of heat given off by the body doing various kinds of work is shown by a table in Chapter XXVI.

Since the fuel needed by the body is measured by

heat, not by work, the value of foods as fuel is measured also by the calories which they are capable of producing.

Although the first three nutrients are all capable of being used as fuel, they are not equally efficient.

1 gram of fat gives	9 calories
1 gram of carbohydrates gives	4 calories
1 gram of protein gives	4 calories

The grown body, doing no muscular work, requires from 2,000 to 3,500 calories per day. Although protein, as well as carbohydrates and fats, is capable of being used as fuel to produce work and heat, yet it should not be used in such quantities as to supply those needs of the body to any great extent. It seems wise to have not more than 300 to 400 calories furnished by protein. The idea that increased protein, as for example, meat, must be eaten to enable one to do hard work, is entirely a mistaken one. The number of calories needs to be increased, not the protein to any appreciable extent. What we know as "muscular strength" comes from the total number of calories, rather than from the amount of protein in the food.

In choosing food to serve at a meal, then, we must know the composition of it so that the body will have the nutrients in a fairly correct proportion, and that we may spend money for nutritious rather than for cheap or expensive food. The price is not an

indication of the food value. Not only calories are to be considered in judging the cheapness or costliness of foodstuffs; the kind of nutrients which they furnish has a share in deciding whether foods are worthy of their price. Although fruits and vegetables yield a small quantity of nutrients in proportion to their cost, yet they are necessary for the diet, because of the particular kind of ash which each furnishes. It is not necessary to buy fresh fruits and vegetables to get this ash. None of it is lost in drying.

With this brief summary of the need for the study of the composition of foods, and of the uses of the nutrients in the body, let us proceed to the detailed study of their composition and of the problems involved in their cooking.

The science of cooking lies in a knowledge of:

1. The proper degree and quantity of heat to be applied to make food materials most easily and thoroughly digestible.
2. The methods of keeping foods from decomposing or spoiling, and of preventing, as far as possible, the spread of infectious diseases by food and utensils.
3. The economical use of fuels and utensils to save money and labor.
4. The composition of food materials in order to combine them in diet so that the nutrients are in the right proportion for the body.
5. The proportions of different ingredients used together to make a digestible and palatable dish.
6. The knowledge of what accurate measuring is.

The art of cooking lies in:

1. The development of flavors which appeal to a delicate and normal sense of taste.
2. The serving of foods with such an appearance and at such a temperature that they are appetizing.

This summary shows how much more there is to be known than is found in an ordinary cook book. Experience has shown and will show how hard it is to have no variation in results. Accuracy and information and judgment are always necessary.

"Bad luck" means carelessness or lack of information. Cooking results, like all others, have a reason. If you make mistakes, find out why they were mistakes and so turn them to your profit.

Measuring. Measuring is the first step in the preparation of a recipe. Inaccurate measuring means:

1. Uncertainty as to the outcome of its product.
2. Many chances of waste of material and labor.
3. Impossibility of comparing results and thereby gaining information.

Experiments 1 and 2 will show how to avoid mistakes in measuring.

Measurements and Weights. The need for a table of measurements is obvious. A table of weights is useful in buying. Many failures in cooking are due solely to lack of standards in measurements; that is, to inaccurate measuring.

A cup means a half pint cup, not a tea cup, or a coffee cup, or a favorite tumbler.

NOTE. The tables in Experiment 3 may be filled out as there is time and need. In order to check the results, repeat each measurement and weight in Experiments 1 and 2.

Experiment 1. To determine a standard method of putting material into a measure.

1. Scoop flour into a cup until level and weigh.

2. Fill a cup as in *1,* shake and fill until level, weigh and compare with *1.*

3. Fill a cup with heaping tablespoons of sifted flour. Weigh and compare weights of flour throughout.

Experiment 2. To determine a table of measurements.

By leveling the measures with the sharp edge of a knife, fill out the following table:

1.	............ss (salt spoon)	equals 1 t	(teaspoon)
2.	............t	equals 1 T	(tablespoon)
3.	............T	equals 1 c	(cup)
4.	c	equals 1 pt	(pint)
5.	............pt	equals 1 qt	(quart)
6.	............qt	equals 1 gal	(gallon)

NOTE. For the following use a spring scale in pounds if possible.

Experiment 3. To determine a table of weights.

	No. of cups	*Material*	*Equivalent*
1.	....	Flour	1 pound
2.	....	Sugar	1 pound
3.	....	Coffee	1 pound
4.	....	Butter	1 pound
5.	....	Water	1 pound
6.	....	Milk	1 pound

Problem. To make coffee for sixty people, allowing 3/4 c water per person and 2 T coffee to 1 c liquid, how much coffee should be purchased?

NOTE. The standard 1/2-pint cup of bread flour weighs 113 grams.

CHAPTER II

SAFE, ECONOMICAL AND CLEAN HOUSEKEEPING *

The Economical and Safe Use of Gaseous and Liquid Fuels. Gas, gasoline, kerosene, and alcohol are used exclusively in laboratories because of the quickness in obtaining heat and the ease in controlling the degree of heat. The economical use of these fuels necessitates some understanding of perfect burning or combustion.

Fire is the rapid combining of a fuel material with oxygen taken from the air of which it is one part in five. We all know that to put out a fire we smother it, deprive it of air by heavy fabrics, sand, or earth. In a furnace or range, if a bed of coals is to be kept with very little burning for several hours, the drafts in the lower doors are tightly closed admitting very little air.

All fuels, no matter what kind, coal, wood, alcohol or gas, contain carbon, hydrogen and oxygen, and other elements as impurities. The problem in using fuel is to supply enough oxygen to

* NOTE TO INSTRUCTORS. It is not thought that all parts of this chapter will necessarily be studied at this point, but different topics from it will be used as seems to work best with the teacher's plan.

burn all of the other elements present. For lighting, not so much air must be supplied, because light comes from glowing, incompletely burned carbon. When heat alone is sought, as in stoves, the flame from gas should be almost colorless, otherwise fuel is wasted. Besides, when the fuel is completely burned the glowing carbon is deposited on the cooking vessels as soot, necessitating constant scouring.

The relation of the supply of air to the color of the flame may be readily seen by loosening the screw to the air control valve on a gas stove burner. Sometimes the air chamber becomes clogged with dirt; also material which has boiled over may have dropped into the perforations thereby producing a yellow flame. The remedy is obvious in the first case; in the latter use a straw or fine wire to clean the holes of the burner.

If the gas lights in the air chamber, a roaring sound is heard and only a small, yellow flame is seen at the burner. Turn the gas off and do not try to light it again until there is no more blaze in the burner. Burning in the air chamber, as this is called, is sometimes caused by holding a match directly over a burner before the gas has had time to reach the perforations. This usually happens when the gas pressure is weak. It also happens frequently when the pilot light is used for lighting the oven burners.

When gas is used, none should be allowed to escape into the room if possible to avoid it. Even in small quantities it is likely to cause headache. All of the joints in the gas fixtures should be tight. Leaks may be found by testing with a lighted match, or for a smaller leak, by putting soap suds around the joint and noticing whether or not any bubbles are produced.

When lighting a gas burner, have the match lighted before the gas is turned on. If the gas lighter is used, hold it in readiness over the center of the burner before turning on the gas.

The Regulation of Coal and Wood Stoves

This is more complicated than the regulation of a gas stove, which is simply by a cock. The amount of air allowed to pass through the bed of fuel determines the briskness with which the fire burns. Air is admitted through a draft in the door or through the door of the ash pit in coal stoves or furnaces, or the front door of wood stoves.

The draft of air through the bed of fire and up the chimney is checked by means of a damper, which can almost close the stove or smoke pipe. When the lower drafts or doors as well as the pipe damper are closed, a still greater check to the fire may be made by opening the drafts or door of the fire box in coal stoves, or by taking off a lid in coal or wood stoves and allowing air to pass over the burning fuel. This

cools the gases sufficiently to prevent burning to any extent. If there has been a good bed of coals to begin with, this method keeps the fire for many hours. A great amount of fuel is wasted by not using these methods of control before an overheated condition is reached.

In building a fire, use plenty of paper, crumpled so as to let air pass around it, and plenty of dry kindling placed cross-wise for the same purpose. When the latter is burning add the heavier fuel but not in such quantities as to stop the draft. What should be the arrangement of drafts?

Do not use kerosene in building a fire. Plenty of kindling makes this unnecessary and avoids the danger of an explosion.

Protection from Fire Hazard

1. If there is a strong odor of gas or other fuel about the stove do not test the burners with a lighted match. The flame would burst and you would at least be in danger of being singed. Try the burners themselves to see that they are turned off.

2. If the odor is strong in the room, do not take a light into it. Open the windows and doors.

3. Do not place boxes of matches on any part of the stove.

4. Do not hang towels on a line where they may fall onto the stove.

5. Use fire lighters if possible; if not, use safety Swedish matches, not parlor matches. In using safety matches, close the box before striking one. The heads, like those of other matches, may be set afire by a blaze.

6. See that the head of the match has ceased to glow before it is put where it may come in contact with paper or cloth. Receptacles for burned matches should be noncombustible. Carelessness in this regard might burn the building.

Cf. "Fire Prevention in the Home," Chapter xxxvi.

Dishwashing. Dishes, knives, forks, spoons, and drinking cups are some of the means of carrying such diseases as diphtheria, tuberculosis, pneumonia, colds, and others from one person to another. Drinking cups used by tuberculosis and diphtheria patients have been found to be free from living germs of these diseases only when they are washed and allowed to stand in boiling water for one minute or when washed in water at 122° F. containing about one-half tablespoon of washing soda to each quart of water. If germs should be in pieces of food or in sputum, such conditions would not be sufficient to kill them. These facts make wise the following precautions in dishwashing:

1. Dishes should be thoroughly scraped before they are put into the dishwater, and the scrapings should be burned or disinfected, in case there are dishes used by a person suffering with infectious diseases which may be carried by saliva. It should be recognized as a fact that people may carry germs in their bodies which might produce disease in another person, although they themselves show no symptoms of it. Consequently there is never a proper time for careless dishwashing. There should be frequent changes of dishwater and the water kept at a temperature of at least 122° F.

2. Rinsing in boiling or at least very hot water would add to the safety and free the dishes of any traces of soda which might be noticeable in appearance or by taste.

3. Dish towels and cloths should be washed in hot water with some washing soda and rinsed after each wiping, to prevent the multiplication on them of any bacteria which might have escaped death in the dishwater or rinsing water.

4. Dish towels should not be contaminated by dust or handling after they have been washed.

It has been found by experiment that thorough wiping with a clean cloth made dishes sterile when careless wiping did not.

Questions: 1. What is the method of washing dishes in public places in which you eat—restaurants, hotels, and soda fountain shops?

2. What would you think of the safety to health in using a dishwashing machine with steam or boiling water? Is scraping important here?

NOTE. An attendant at a soda fountain cleaned a glass, from which ice cream soda had been drunk, in the following fashion. It was plunged, inverted, into a pan of water said to be hot, but showing no signs of vapor rising from its surface. The water was admitted to have no means of being heated as time went on and to have no soda or like material in it. The glass was withdrawn immediately and set to dry upside down on top of another. It is true that no soiled towel was used in this process. Was this safe dishwashing?

3. Is soap necessary, when washing soda is used, in order that the grease may be easily removed from dishes?

CARE OF UTENSILS AND EQUIPMENT

1. Clean graniteware by soaking and boiling, not by scraping.

2. Clean aluminum stained by water with weak acid; for example, sour milk or vinegar.

3. Clean silver by putting a few pieces at a time into a bright tin or aluminum vessel containing a solution made of one tablespoon of baking soda and one tablespoon of salt to each quart of water. If the tarnish is heavy, the utensil must be rubbed with a cloth after it is taken from the water before it will appear bright.

4. Wood used in table tops, unprotected by paint or a covering, may be roughened or darkened.

a. To remove dents. Put a wet pad of several thicknesses of cloth over the dent and cover it with a hot iron. The steam will raise the fibres of wood.

b. To smooth out a rough place. Rub with the grain of the wood, using steel or mineral wool.

c. To restore color if darkened. Use steel wool and weak hydrochloric acid. Fine sand is better than soap for scrubbing wood, because the alkali in soap combines with wood to form a dark stain which is really a kind of ink. Scrubbing should be done with a circular motion of the arm for best and easiest cleaning. Rinsing and drying should be done with the grain, however, to leave the fibres flat.

5. Enameled sinks should be scrubbed with very finely pulverized cleaning powders. No acid or lye should be allowed to touch the enamel.

6. All material should be poured into the sinks through a fine strainer. Unless there is a large quantity of very hot water always on hand, a grease trap should be provided under kitchen sinks. The traps may be cleaned by putting a little powdered lye on the metal drain plate and allowing water to drip onto it over night. This is scarcely necessary when there is always an abundant supply of very hot water.

7. Stoves may be kept polished and cleaned with paper or cotton waste, or they may be washed after each using. The latter method is easier and cleaner. Spilled materials

should be thoroughly removed before they are allowed to dry. If stoves are to be left unused, it is wise to rub their surface with a light coating of oil or fat to prevent rusting.

8. Garbage cans should be kept sweet and clean.

9. Steel knives and forks should be prevented from rusting or discoloring. Whenever possible this should be done by washing and drying them immediately after using.

10. The wheels of Dover egg beaters should not be put into water when the beaters are washed.

11. No spilled or decomposing food should be left in a refrigerator. This decomposition may, in case of mold, spread to other food, or odors from it may be absorbed by milk and butter. The milk should be kept covered and the butter wrapped in oiled paper. Fish and other strong smelling food materials should be wrapped in paper or have the utensils on which they are held slipped into paper bags and the opening closed.

All parts of the refrigerator should be washed in hot, soapy water at least once a week. Where fruits and vegetables are kept in it, twice is better, since these contain many molds and bacteria. The drip pipe is the lodging place for an ooze-like substance formed from most ice. In time this acquires a musty odor. To prevent this, hold each end of the drip pipe in turn under a strong stream of boiling water. It should be kept so clean that no particles will be found in the water as it leaves the pipe. The drip pan should be cleaned frequently, or, if a drain is used, it should be well flushed with hot water.

12. To avoid attracting ants, roaches, mice, etc., keep all supplies in closed cases of glass or metal. Keep all tables, drawers, cupboards, stoves, and utensils clean all of the time. Do not allow a dirty, disorderly condition to exist. The cleaning which means a general upheaval of order is generally a sign of poor management.

13. Regarding the transferring of disease from one person to another in the course of laboratory work, read Chapter XXX.

The Processes of Cooking to Which the Different Metals Are Best Adapted. All metals are conductors of heat. You know how hot the silver spoon becomes when left in the cup of hot liquid; how hot a tin or aluminum cup becomes when hot liquid is poured into it; how hot a saucepan handle quickly becomes. Earthenware becomes hot much less quickly. The metals, copper, aluminum, iron, enamel, tin are not all equally good conductors; that is, carriers of heat.

Silver is the best and is rated at 100. Other materials are given numerical values comparing them with silver as follows:

Silver	100	German silver.	6.3
Copper	74	Water	.083
Aluminum	38	Glass	.046
Tin	15	Hard rubber..	.024
Iron	12	Gases, *e.g.*, air.	.0033

On account of their different conductivities some utensil materials are better suited to certain cooking processes and foods than others. The following shows to what the various materials are best adapted.

1. *Aluminum.* Quick heating and cooling; *e.g.*, syrup and candy making, jelly making, boiling fruits and veg-

etables, milk and cereal steaming, as well as for measuring utensils, such as cups. Handles of aluminum vessels should be made of a more slowly conducting material.

2. *Tin.* Less rapid heating and cooling; *e. g.,* cake baking.

3. *Iron or Steel.* (*a*) Heavy—For still less rapid transfer of heat than tin; pot roasts, frying pans for pan-broiling steaks and chops.

(*b*) Sheet iron—Frying pan for bacon and thinly sliced liver; pans for oven roasts, bread pans.

4. *Earthenware.* For cooking for a long while at a low temperature, when browning is not necessary; bean pots, casseroles for soufflés and stews. Soapstone for griddle.

5. *Graniteware.* This may be used instead of aluminum and also in place of sheet iron roasting tins. It is found to be the best material for pie pans.

Characteristics of Different Metals Used in Cooking Utensils

1. *Copper.* It forms harmful compounds when not kept absolutely bright. Therefore, it is abandoned in homes, although it is used in preserving factories. It is very expensive.

2. *Aluminum.* It is light in weight, does not rust, but stains from hard water, and is rather costly. It has been known to corrode when food is allowed to decompose in it. So far no cases have been proved against aluminum as forming harmful compounds when food is cooked in it. The water stain is easily removed with a weak acid solution.

3. *Tin.* This is only a coating of tin over iron. The coating is often very thin, as is shown by the readiness with which supposedly tin vessels rust. Iron rusts, tin does not. Tin discolors and is easily scratched through. Heavy block tin is the best to buy.

4. *Iron and Steel.* At least the inside of the vessel should be smooth. Nickel plating is frequently applied to metals to insure this and make the utensils more attractive.

5. *Enamelware.* This is made by coating sheet iron or steel utensils with an enamel, a specially prepared glassy substance, that is either sprinkled on the dry steel as a powder, or mixed with water and floated on as a cream. This is then melted by being put into a glowing furnace for a minute. Two or three coats are applied successively. The quality depends upon the ingredients used, not on the number of coats applied, and upon the firmness of the steel or iron foundation. If this can be easily bent or dented, the enamel will crack or chip. This makes enamel spoons impractical. Royal Gray graniteware is less expensive than some other kinds, but it wears very satisfactorily. Proper care in using this ware is important. It should never be heated directly over a flame without having sufficient liquid in it to cover the bottom; it should be cleaned by soaking and boiling, not by scraping; it should be protected against sudden changes of temperature; it should be handled as though it were glass. These precautions aid in avoiding chipping.

It is more economical for reasons of cleanliness and freedom from burning to use first-class, non-cracking ware, whatever the effect of bits of enamel or of food acids upon the foundation material may prove to be.

6. *Earthenware.* Ware that does not chip and stands heat and acids has a hard, smooth, glassy surface. The clay from which it is made must be free from iron to make it fire proof. Cheap earthenware is easily scratched or covered with fine cracks and chipped, exposing a porous surface to discolorations at least.

CHAPTER III

THERMOMETERS AND BOILING

Equally as important as correct measuring is control of the heat used for cooking. Toughness of meat and eggs, lack of flavor in soups, unevenness in baking of cakes and bread, stickiness and hardness in syrups and candies may sometimes be caused by use of a wrong temperature. For many things there is a range of several degrees in which satisfactory results may be had. Other things require a definite temperature, a certain degree. Much uncertainty may be saved by the use of thermometers in cooking. Until they come into more general use it is helpful to use them in class for determining tests for temperature which may be made without their use; for instance the appearance of water at certain temperatures, and the thread and ball tests for syrups.

The first thing to be learned about any kind of cooking is how to use fuel economically. To do this when cooking in water, it is necessary to know its temperatures as indicated by its appearance. For this use a thermometer.

Thermometers. Thermometers are instruments which register temperature. They are glass tubes enlarged at one end, into which mercury or alcohol

is put. The glass is extended out from the bulb to various lengths, leaving a tiny even bore or hole in the center. The length depends upon the temperature which the thermometer is to measure. Above the liquid in this bore there is nothing, no air to press upon the liquid. The mercury in the bulb rises and falls in the bore as the thermometer is exposed to various degrees of heat, because it expands and contracts more than the glass in the bulb.

When a thermometer is to be marked with a scale, the freezing point is fixed by immersing its bulb in melting ice and making a mark showing the height of the column of mercury. The boiling point is determined similarly, for ice substituting distilled water boiling at sea level, and holding the thermometer in the steam just above.

In 1704, Fahrenheit divided the space between these two marks into 180 parts or degrees, making the Fahrenheit thermometer. Christian, in 1743, divided it into 100 parts, and this is the Centigrade scale which is used largely in scientific work.

Care of Thermometers. 1. Do not put them in a place where they may be struck and injured.

2. Clean them as soon as they are taken from a mixture, not by holding them under a faucet or dipping into water, but by wiping them carefully with a moist warm cloth. Be sure that they are absolutely clean. A black speck or a drop of syrup on a thermometer used in an oven will heat the glass more in that spot and may break the thermometer. Keep them bright, without a blemish.

PROBLEMS IN TRANSFERRING READINGS OF FAHRENHEIT AND CENTIGRADE SCALE

100° C = 180° F.; 1° C. = 9/5° F.; 1° F. = 5/9° C.

(*a*) 68° F. room temperature = (68 − 32) 5/9 = 20° C.

(*b*) 23° F. temperature of ice cream = (23 − 32) 5/9 = − 5° C.

(*c*) 383° F. temperature of oven for butter cake = (383 − 32) 5/9 = 195° C.

(*d*) 37° C. body temperature = (37 × 9/5 + 32) = 98 3/5° F.

Experiment 4. To determine the changes in appearance when water is brought to the boiling point, and the temperatures indicated by these changes.

Discussion. As water is heated the air which is dissolved in it is first seen as small bubbles on the bottom and sides of the pan, then rising through the liquid to the surface and disappearing. The largest bubbles breaking on the surface are steam, which condenses as soon as it reaches the surface. In this form it is properly called a vapor.

When the mercury ceases to rise the boiling point has been reached although the mercury may not register 100° C., or 212° F. The temperature at which water boils depends upon the length of the column of air which presses down upon it and upon

NOTE TO TEACHER. If both kinds of thermometers are used, put scales on the board, number every 5° on Centigrade scale and 9° on Fahrenheit scale and draw connecting lines.

NOTE TO STUDENT. If the temperature of the water is to be taken, do not let the bulb of the thermometer touch the pan. The metal is hotter than the water.

the other factors which influence air pressure. Therefore, the altitude affects the boiling point noticeably. For each rise above sea level of about 1,000 ft., the boiling point drops 1° C., or 1⅘° F.

Directions. Fill a saucepan half full of water and, keeping the gas low, bring it to the boiling point.

Observe temperature:

a. —° C. —° F. at which bubbles appear on the sides and bottom of pan.

b. —° C. —° F. at which larger bubbles come and break before they get to the surface.

c. —° C. —° F. at which the larger bubbles rise and break on the surface.

d. —° C. —° F. at which mercury ceases to rise. This is the boiling point.

e. Turn the fire as low as possible and still keep the highest temperature. Note the appearance of the water now.

f. 1. Boil water fast for 3 minutes. Notice difference in amount.

2. Turn gas as low as possible and still keep it at the boiling point for 3 minutes. Compare amount lost in *f, 1,* and *f, 2.*

Conclusions. 1. At what altitude are you?

2. When would fast boiling be economical?

3. When is gentle boiling better?

Problems. 1. At what temperature does water boil at Denver, 5,000 feet above sea level?

2. At the Dead Sea, 2,000 feet below sea level?

3. How would each place affect the preparation of vegetables cooked in water?

To prove that the small bubbles are air, and to show the

effect of dissolved air upon the taste of water, the following experiment may be performed:

Directions. Boil water rapidly for from 3 to 5 minutes. Then divide it into two parts. Allow part 1 to cool until it is below the temperature at which you first saw bubbles in experiment *4*. Pour part *2* back and forth into another vessel through the air several times and allow it to cool the same as *1*. Taste each, and then re-heat and notice the temperature at which the first bubbles are seen. Apply this to making boiled water palatable for drinking.

As has been seen, when water is heated, the temperature rises to a certain point and then, under those conditions, will rise no higher in spite of the continued application of heat. When this point is reached water is said to be boiling and steam begins to be formed. Steam shows the same temperature as the boiling water. As has also been shown, gas under boiling water may be turned off to some extent without lowering its temperature. When more heat is used than enough to keep the water just at the boiling point, the water is changed from a liquid to a gas, steam. To change one kilogram or 2.2 lbs. of water at the boiling point into steam requires 537 calories, 5 times as much heat as to raise that amount of water to the boiling point. Heat is never lost but is given off to the things with which it comes in contact. So when steam is condensed, that is, returned to a liquid state, by coming into contact with a cooler substance, it gives off to the object with which it comes in contact, the heat which was

required to change it from boiling water into steam. The steam, however, shows no higher temperature on a thermometer than boiling water.

Questions. 1. Can you explain why a burn from boiling water is less severe than a burn from steam?

2. When the steam is confined and condenses on the food to be cooked, would you consider fast boiling extravagant?

3. What would be the effect upon the amount of time and fuel required when steaming is used in place of boiling?

It is sometimes desirable to have a higher temperature than that at which water boils. The chief use of this is in the household in cooking fruit. By supplying more heat, as is done with a syrup, the time for cooking is shortened and the fruit may be kept in large pieces. Other substances may be added to water and its temperature raised above its own boiling point.

Experiment 5. To determine how the boiling point at a given place may be changed.

Directions. In each case add a given amount of material to 1 c water, boil, and record temperature.

a. 1 T salt —° F., then add 1 T more —° F.

b. As many more as will affect the temperature —° F.

c. 1 T sugar —° F., then add a second T —° F. Continue boiling until a thick syrup is formed. Record temperature. Change these observed temperatures to the corresponding Centigrade scale. Save this syrup for apple sauce.

d. 1 T sawdust —° F., add a second T —° F.

Conclusions. 1. What must be the condition of a substance in order to change the temperature of the boiling point?

2. What is the effect of quantity of material on the temperature?

Boiling points of various substances at sea level:

Water 100° C.;	Ammonia –33° C.
Ether 38.5° C.;	Alcohol 78° C.

Change these to Fahrenheit readings.

Experiment 6. To determine the temperature inside of double boiler, and how it may be increased.

Directions. Put water in a small double boiler. When the water in the lower part is boiling, take the temperature of that in the inner part, keeping the lid on. Take the lid off and record temperature. Add coarse salt to lower part of boiler until the water on the inside boils. Apply this to the reheating of cereals.

REFERENCE. Millikan and Gale, "Elementary Physics," pp. 203-207.

CHAPTER IV

FRUITS

Fruits have been selected as the first food to study because of the simplicity of their composition and preparation. The preparation requires attention to the principles of boiling, and to the amount of sugar needed to flavor.

Composition. Fresh fruits are composed largely of water. Even bananas are about ¾ water, strawberries $\frac{9}{10}$, and watermelons and rhubarb even more. They contain on an average about 1 per cent of protein, less than that proportion of fat and of ash, and from 3 to 21 per cent of carbohydrate in the form of sugars or starch.

The Importance of Their Use in the Diet. The carbohydrate and the ash are the nutrients which make fruits valuable in the diet. The sugars are not as necessary as the ash, for although this is found in exceedingly small, almost minute quantities, it is exceedingly important. Vegetables, fruits, and milk leave, when they are burnt outside the body or used in the body for its purposes, an ash with an alkaline effect or reaction. The ash found in cereals, meat, and eggs has an acid reaction. This may sound strange since fruits taste sour or acid. In the body their acids are broken up and

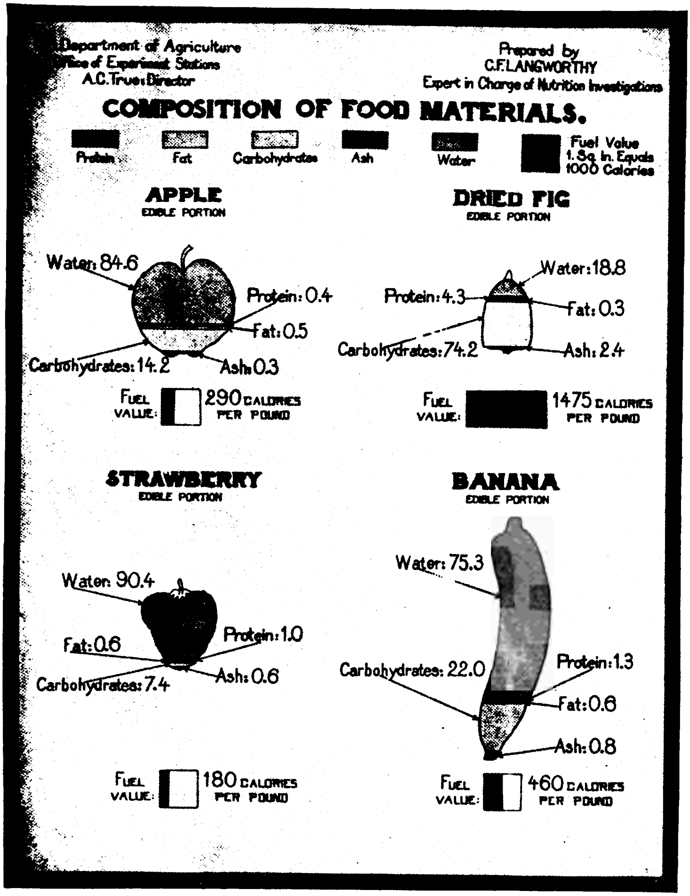


Plate 2.

Make a list of fruits in plates 2 and 3 according to (1) the amount of ash they contain, (2) the amount of carbohydrates.

their effect is alkaline. For good health in adults and for the greatest growth of healthy bodies in children and infants, it seems probable from experiments on animals that the diet must be chosen so that it does not consist alone or largely of cereals, eggs, and meat. The bulkiness of fruits and vegetables is supposed to be beneficial in counteracting a tendency to constipation.

Effect of Ripening on Composition. Ripening is believed to be brought about by certain kinds of chemical substances very sensitive to temperature, called enzymes. The form in which the carbohydrate is found depends upon the stage of ripeness. In general, ripe fruits are less sour than green fruits and contain less starch and fibre and more of the different sugars. They also contain less of the jelly producing substance, pectin. These facts explain why:

1. Jelly should be made of underripe fruit.
2. Cider should be made from very ripe apples, since the amount of sugar in the apples determines the quality of the cider and the vinegar, if that is to be made from the cider.
3. Only very ripe bananas, in which much of the starch has been changed to sugar, should be eaten raw. It seems probable that failure to follow this rule may be the cause of many of the digestive disturbances which follow the eating of bananas. This is particularly true because the softness of the banana makes thorough mastication seem less necessary.

Color of Fruit. If pared or cut fruit is exposed to the air, it rapidly turns dark, due to the effect of certain enzymes upon some of the other constituents of fruit in the presence of air. This effect may be largely prevented by covering pared apples thoroughly with several thicknesses of wet cloth or with water. This applies also to potatoes. The brown bruised spots in apples are due to the same cause. These spots contain a greater proportion of starch than the rest of the apple, since this process hinders the change from starch to sugar.

Flavor of Fruit. Fruits owe their flavors in a large measure to the sugars and acids which they contain. But the flavor which identifies a fruit particularly is a substance which easily passes from it as a gas or a vapor, as it is cooked or dried. This accounts for the great preference for fresh rather than for cooked or dried fruits, however well those processes may have been carried out.

The flavor of a fruit varies with the temperature. Some people like them cold, others only cool, and still others fresh from the garden, warmed by the sun.

The Structure of Fruit. The fruit, like the rest of the plant, is made up of cells. The walls of these are cellulose, and inside is the protoplasm containing all the kinds of material which the plant requires for its various functions. Some cells more than others are made the depository of reserve material,

and so we find in fruits reserve carbohydrate, which is also found in the roots or seeds of some vegetables.

The Cooking of Fruit. When fruit is cooked, these cell walls and the deposited starch, if there is any, are softened, and the fruit becomes more easily masticated, more palatable, and more readily digestible. Cooking also kills the bacteria and molds that may have been on the fruit from its exposure in its growing condition and in subsequent packing and handling. Washing cannot produce thorough cleansing, since the surfaces of fruits are uneven and rough. It seems likely that the digestive disturbances which sometimes follow the eating of green fruit may be due to the presence of bacteria on the fruit which has been picked up from the ground.

Soft fruits are generally cooked, unless they are for immediate use, in order to prevent their decay, which is due to the growth of molds and yeasts. To keep fruit indefinitely these must be killed and no more allowed to come in contact with the fruit. This need of keeping fruit from season to season has developed the processes of canning and preserving. Simpler than these is the process of drying, by which so much of the water is evaporated from the fruit that no molds or yeasts will grow upon it.

In the cooking of fruits there is a simple and important application of the work on the use of water, or water plus a dissolved substance, in this case sugar, to convey heat to a material to be cooked.

Suppose some soft fruit is to be cooked and it is desired to keep the pieces whole. How should it be cooked? The following experiment will help to solve this.

Experiment 7. To compare the softening effect of cooking an apple in syrup and in water, noting the difference in time.

Directions. *a.* Cook a piece of apple in a syrup made of one-third to one-half as much sugar as water.

b. Cook the same sized piece of apple in water until tender. Flavor, using the same amount of sugar as in *a.*

Compare time, appearance, and flavor.

Conclusions. 1. What method will you use when you want to keep fruit whole?

2. Give difference in results and use of the two methods.

3. Apply this in making apple sauce.

Coddled Apples. Coddled apples are pared, cored, and cooked in a syrup. A stick of cinnamon may be put into the syrup. The syrup may be boiled down and poured over the apples when they are served. A bit of currant or other kind of jelly may also be put on top of each apple. From *Exp. 7* determine what the proportion of sugar and water should be. What determines the amount of these to be used?

NOTE. Where several apples are used, ½ as much sugar as water is not too large an amount, but in cooking part of an apple ⅛ as much sugar is usually sufficient.

REFERENCE ON FRUIT. "Use of Fruit as Food," Farmers' Bulletin No. 293.

Unless otherwise stated, the bulletins referred to may be obtained for five cents each from the Superintendent of Documents, Washington, D. C.

For Family Use. When more syrup is used in coddling apples than is desirable for juice, it may be put into a can and sterilized according to method *3,* under *Canning,* until it is to be used again, when it may be diluted with water as necessary.

Baked Apples. Wash the apples, remove the cores and place in a pan in which there is enough water to cover the bottom. Almost fill the cavity of the apples with sugar. A very small piece of butter may be placed on top of each apple. Cover the pan and bake the apples until tender. Spices may be added if desired. If the apples are very sweet a little lemon juice is a pleasant addition.

A card 3x5 inches is a convenient and standard size for an index box. A suggested order for the recipe is also given.

MIXED FRUIT ICE

3 oranges	1 c apricots
3 lemons	3 c sugar
3 bananas	3 c water

Squeeze oranges and lemons and put bananas and apricots through a sieve. Cook sugar and water together to make a thin syrup (10 min.). Add pulp and juice and freeze.

Note. In addition to a laboratory note book, keep a card catalogue of the best proportions, methods of mixing, and cooking temperatures which are derived from each experiment and also of amounts made by the quantities of material used.

Experiment 8. To apply the principles of cooking fruit in sugar to the cooking of cranberries.

Directions. Cook so as to:

a. Keep berries as whole as possible.

b. Give a thin sauce without skins.

In each case measure the berries before cooking and add a measured amount of sugar.

c. Make cranberry jelly.

Proportions. 1 qt cranberries, 2 c water.

Cook the cranberries in water until they are thoroughly soft. Add two-thirds as much sugar as pulp and cook with the cranberries until two drops hold together when the mixture is dropped from the spoon. The cranberry skins may be removed by straining. In this case the sugar should be added to the pulp after the removal of the skins. Why? If the cranberries are very acid, it is sometimes better to increase the sugar to equal proportions.

Conclusion. Formulate a recipe for each method of cooking cranberries.

CHAPTER V

CANNING

Canning is a process by which any foodstuffs which might be ruined for use by bacteria, yeasts, or molds, if kept raw or even if cooked and exposed to the air, may be protected from these for an indefinite length of time. This is done by sterilization, which is the process of making them free from living organisms. These three kinds of tiny plants or microorganisms may be present on the food itself, on the jars and other utensils, or in the air around them. They are so small that a single bacterium, or yeast plant, cannot be seen without a high-power lens, and a single mold plant of most varieties needs a low power lens. When one thinks of how numerous and how small these plants are, it is not strange that many cans of fruits and vegetables are wasted every year because of imperfect canning. To prevent this great waste of labor and material, the following points must be understood:

1. Where these bacteria, yeasts, and molds may be present.
2. How they may be killed.
3. How they may be kept from entering the can of sterilized fruit and "spoiling" it.

To show these points, perform the following experiments:

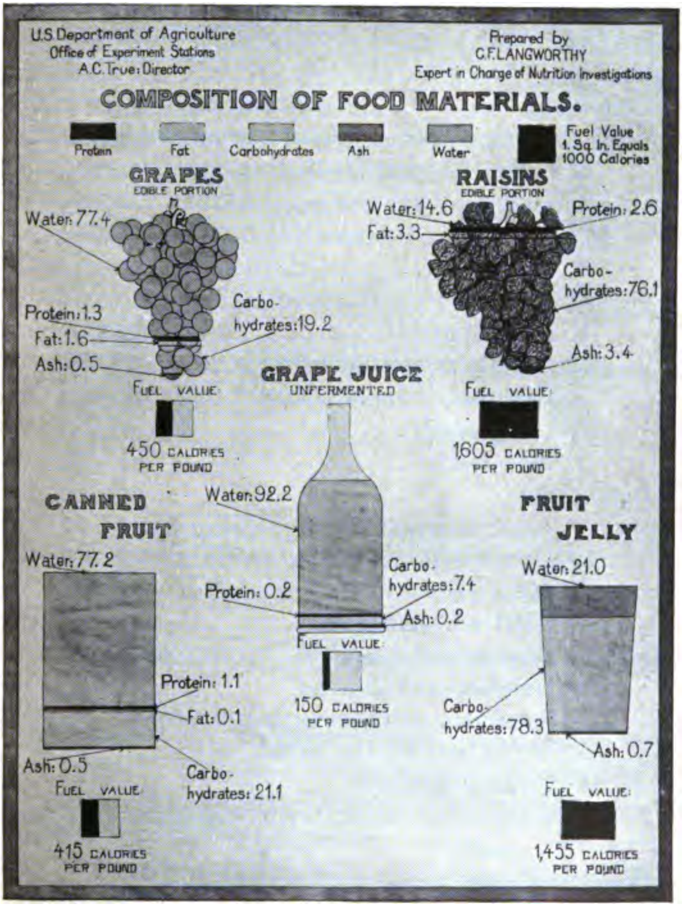

U.S. Department of Agriculture
Office of Experiment Stations
A.C. True: Director
Prepared by
C.F. LANGWORTHY
Expert in Charge of Nutrition Investigations
COMPOSITION OF FOOD MATERIALS.
Protein
Fat
Carbohydrates
Ash
Water
Fuel Value
1. Sq. In. Equals
1000 Calories
GRAPES
EDIBLE PORTION
Water: 77.4
Protein: 1.3
Fat: 1.6
Ash: 0.5
Carbo-
hydrates: 19.2
FUEL VALUE:
450 CALORIES
PER POUND
RAISINS
EDIBLE PORTION
Water: 14.6
Protein: 2.6
Fat: 3.3
Carbo-
hydrates: 76.1
Ash: 3.4
FUEL VALUE:
1605 CALORIES
PER POUND
GRAPE JUICE
UNFERMENTED
Water: 92.2
Protein: 0.2
Carbo-
hydrates: 7.4
Ash: 0.2
FUEL VALUE:
150 CALORIES
PER POUND
CANNED
FRUIT
Water: 77.2
Protein: 1.1
Fat: 0.1
Ash: 0.5
Carbo-
hydrates: 21.1
FUEL VALUE:
415 CALORIES
PER POUND
FRUIT
JELLY
Water: 21.0
Carbo-
hydrates: 78.3
Ash: 0.7
FUEL VALUE:
1,455 CALORIES
PER POUND

Plate 3.

Experiment 9. To determine what makes fruit spoil.

Directions. Allow fruit to stand under the following conditions:

I. Whole Skin.

a. Room temperature. (Apple, Plum, Peach, Grape.)

1. Light and moving air........................
2. Light and quiet air.........................
3. Dark and quiet air..........................
4. Wrapped ....
5. In sawdust ....
6. In contact ....

b. Refrigerator temperature 50° F.

1. Wrapped ....
2. Unwrapped ....
3. In contact..................................

II. Broken Skin.

Repeat *I,* using pieces of fruit or broken fruit.

a. Form conclusions as to effect on the growth of micro-organism of:

1. Light and darkness.
2. Moving and quiet air.
3. Moisture and dryness.
4. Room and refrigerator temperature.
5. Whole and broken skins.
6. Texture of skins.
7. Sources of molds, with explanation of your answer.

Show how these principles apply to:

1. Storing or shipping of apples.
2. Temporary keeping of peaches, berries, etc.

NOTE TO INSTRUCTOR. *Experiments 9* to *17* may be done in a very short time by assigning to each pupil a part of each experiment. Labels should then be carefully affixed and the results of all parts of the experiments watched by everyone.

3. Exhibiting of apples, oranges, etc., in windows or on the street.

Experiment 10. To test the effect of various antiseptics upon mold growths.

Those substances which hinder the growth but do not kill the microorganisms are called antiseptics.

Directions. To test tubes containing pieces of fruit add:

a. Thin syrup of 1 part sugar to 3 parts water. Cool before adding to the fruit.

b. Thick syrup 2 parts sugar to 1 part water. Cool before adding to fruit.

c. Vinegar. (*a*) 1 part vinegar and 3 parts water; (*b*) 1 part vinegar and 1 part water; (*c*) all vinegar.

d. Water, cold.

e. Oil.

f. Alcohol.

g. Water and spices (heated first).

h. Formalin on whole crab apples, 5% solution.

i. One part brine (saturated solution of this), 3 parts water.

Apply to preserving, jelly making, pickling and exhibiting of fresh fruit.

Experiment 11. To discover how molds injure foods.

Directions. a. Study individual mold plants under the microscope. Notice parts. What are the functions of each? Find different varieties of molds.

b. Plant mold on a can of fruit syrup. Watch growth from day to day.

c. Smell molded fruit. Taste syrup of *b*.

d. Remove mold from jar of fruit. Taste fruit. Boil and then taste.

Conclusions as to: 1. How molds are reproduced.

2. How they get their food.

3. Effect upon taste of food upon which they grow.
4. Kind of substances produced.

Experiment 12. To determine the temperature and time necessary to kill molds.

Directions. Heat a small quantity of fruit and water (enough to fill 6 test tubes) in a sauce pan to:

a. 150°-160° F.
b. 180° F. for 1 second.
c. 180° F. for 5 minutes.
d. Boil for 1 second.
e. Boil for 5 minutes.
f. Boil for 15 minutes.

As each temperature is reached and held for the time required, fill a test tube which has been boiled for 15 minutes. Fill them with the fruit so that there is no air space left. Cork them quickly with corks boiled for 15 minutes. Dip the tops in melted paraffin.

Conclusions as to: 1. Death temperature for molds.

2. How to prepare glassware for holding fruit preparations.

Apply to: Temperature and time used in canning fruit to prevent mold growth.

Experiment 13. To determine sources of molds other than fruit and jars.

Directions. *a.* Repeat *Exp. 12,* taking no pains to cork the tubes quickly.

b. Repeat *Exp. 12,* leaving a short column of air in the tube, and corking the tube quickly.

Conclusions. 1. As to the cause of the results of sealing in *a.*

2. As to the effect of the air column in the tube.

3. As to sources of mold in canned fruit.

4. Make a list of possible causes for the appearance of mold growth in a can of fruit.

Experiment 14. To determine the structure of yeasts.

Directions. Look at yeasts under a lens. What is the shape, the color, the method of reproduction? Notice vacuoles and fat drops.

Experiment 15. To determine the effect of yeasts upon fruit juice.

Directions. Put apple juice and pulp into four test tubes.

a. Expose one to the air for several days.

b. Boil and seal one.

c. Boil and leave one open.

d. Add yeast, dried or compressed, to one.

Notice bubbles, taste, odor, and time in which they appear. When fermentation occurs, test each with litmus paper; also fresh juice. Compare. Examine a drop of each under the microscope for yeasts.

e. Boil *a* and taste again.

f. Let *d* stand until vinegar begins to form, due to acetic acid bacteria. How do you test for this? Vinegar contains acid.

NOTE. When litmus paper is put into a liquid note result:

a. change blue litmus to pink, showing the presence of an acid.

b. change pink litmus to blue, showing the presence of an alkaline substance.

c. change the color of neither pink nor blue, in which case the liquid is neither acid nor alkaline; it is neutral to litmus.

Conclusion. 1. Source of yeast.

2. Effect of heat on products of yeast growth.

As yeasts grow, they feed on sugars and in doing so change them into alcohol and carbon dioxide (CO_2), a gas. This is the process in the making of cider. After a few

months, if cider is left in a warm place, acetic acid bacteria, by changing the alcohol to acid, make vinegar. Growing yeast plants are killed by a temperature of 129° F., yeast spores by 143° F.

Experiment 16. To determine the causes for the spoiling of other food materials.

Directions.

a. Into test tubes put:

1. Water.
2. Pieces of bread and water.
3. Egg and water.
4. Meat and water.
5. Milk.
6. Tomatoes.
7. Corn and water.
8. Dried beans and water.
9. Dried peas and water.
10. Turnip and water.
11. Cabbage and water.

b. Repeat *4*, *6*, *7*, and *8*, boiling for 15 minutes before putting into sterilized test tubes. Fill these and seal with sterile corks. Compare these. Keep at room temperature, corked and sealed. Notice from day to day gas and odors formed. Compare with specimens of decomposition due to molds and odors from growth of yeasts. The other decomposing agents are bacteria.

Conclusions as to: 1. Agents causing spoiling.

2. Signs of spoiling.
3. Kinds of foods most readily spoiled.
4. Does 15 minutes boiling kill all the micro-organisms?

NOTE. Some bacteria form spores, hard seed-like structures which live where the growing bacteria could not on account of dryness, temperature, or lack of food. The acid and the higher temperature

The Thickness and Amounts of Syrups Used in Canning

1. Use a syrup of 1 c sugar to 2 c water for soft fruit, such as peaches, soft pears, and pineapples.
2. Use a syrup of 1 c sugar to 3 c water for hard fruit, such as pears and quinces.
3. For soft, juicy fruit, such as plums, cherries, strawberries, raspberries, and blackberries, use enough water to cover the bottom of the vessel. Add one-fourth or one-third as much sugar as fruit, according to the acidity of the fruit. Blueberries and raspberries are so sweet that they require less sugar, one-twelfth as much sugar as fruit being used for blueberries, one-sixth as much for raspberries. In these cases the sugar is put on the fruit without being made into a syrup previously. If these fruits are canned in the steam bath or oven, mix the fruit and sugar well before putting them into the jars.

There are three methods of canning fruit. In each case the preparation of the fruit and syrup is the same. The difference lies in the method of conveying heat to the syrup and of sterilizing the cans.

For the syrup: Use about 1 pt of syrup to 1 qt can of large fruit and about ½ pt syrup to 1 qt can of small fruit.

1. The heat may be carried to the syrup through the saucepan, in which case the can is sterilized separately.

due to sugar used make it easier to kill these on fruits than on vegetables. What, then, would be the time to produce sterilization in fruits? Further on, the sterilization of vegetables will be discussed.

REFERENCES. Conn, "Bacteria, Yeasts, and Molds in the Home." Buchanan, "Household Bacteriology," pp. 55-84 (for teachers).

2. The heat may be carried to the syrup and fruit in the jar by boiling water and steam. Thus the jar is sterilized as the fruit is cooked in it.

3. The heat may be conveyed to the syrup and the fruit in the jar by hot air in the oven.

Method 1. To sterilize the can, put a cloth, a piece of paper, or some non-conducting material on the bottom of a pan. Put the jar and the lid into the pan of water, so that the jar is filled. Boil the water for 15 minutes. If the rubber is hard it may be placed in the water with the cans, if soft, dip it in boiling water. Sterilize at the same time a silver fork. If the jar is ready before the fruit is and it is desirable to take it out of the water, let it stand, inverted, on a clean surface. Whenever the cover is removed it should be laid on a clean surface, top side up. Leave the fork in the hot water. When the fruit is tender, turn the can right side up on a pie pan or similar dish and put on the rubber. With the silver fork, put such fruit as peaches and pears into the jar with the convex side of the fruit next to the jar. Small or very soft fruit may be poured into the jar from the saucepan, leaving the fork standing in the jar, that the silver, a good conductor, rather than the glass, may take the heat and prevent the breaking of the glass. Fill the jar to overflowing, keeping the temperature of the fruit in the kettle at the boiling point while the filling is being done. Why? Screw the cover on tight, wipe the jar and

invert for a few minutes to see if any juice oozes out.

Questions. 1. To what is the decrease in volume as the fruit stands due?

2. Why is this space not dangerous, while one which is caused by not filling the jar to overflowing may be dangerous, so far as the keeping of the fruit is concerned?

Method 2. Steaming. Pack the washed jars with fruit, fill the jars with syrup and put on the rubber and the lid tight. Place enough water in a boiler to about ¾ cover the jars. Place the jars on a wooden rack or on cloths or paper and cover the boiler close. Cook the fruit until it looks soft.

Method 3. Oven. Prepare the fruit in the jars as for steaming, except to fill them to within about 1 inch of the top. Screw the cover on loose. Why? Place the cans on a thick piece of asbestos paper in the oven. The oven may be heated beforehand. When the fruit reaches the boiling point, lower the temperature of the oven so that the fruit does not run over. A temperature of 140° C. or 284° F. in a gas oven will be sufficient after the fruit has reached the boiling point. This is a temperature which feels barely warm to the hand. Cook the fruit until it looks soft. When the fruit is cooked and the jars are removed from the oven, boiling juice or fruit or syrup may be added to fill the jar. Keep the lid top side up while adding the syrup. Would there be

any danger in leaving this air space? Care must be taken not to set the hot jars in a draft or on cold material.

Conclusions. What are your conclusions as to the best method, considering convenience, time, and amount of fuel?

The sterilization may be tested by noticing the top of the can a few days later. If a metal cap has been used, it should be slightly concave. If it is convex, gas must be forming on the inside, the pressure of which produces this bulge. If glass tops are used, throw off the wire clamp; if the lid comes off easily, gas must be forming inside. If the contents of the can were sterilized the shrinkage of the air on cooling would make the pressure less on the inside than the outside and the lid would have to be pried off.

Sterilization of Vegetables by Canning. For the sterilization of vegetables a higher temperature than boiling point, or the boiling point for a longer time, is required than for the sterilization of fruits, as has been said. Bacteria which produce spores are hard to kill in canning vegetables at home. The bacteria themselves are readily killed by boiling water, but the spores, to be killed, require about five consecutive hours of boiling, or better, one hour of boiling on each of three successive days. The hours of boiling must be counted from the time that the liquid in the can begins to boil. Care

must be taken that the lids are kept tight during the intervening days. This method is called intermittent sterilization. Tomatoes seem to be an exception to this rule, probably on account of the acid. This intermittent sterilization is best carried on in the oven, although steaming may be used. Why?

The most difficult vegetables to can are peas, beans, corn, and asparagus.

When intermittent sterilization is used, the first hour of boiling kills all bacteria. During the following day the spores have the right conditions of food, temperature, and moisture to become bacteria again. The third day's boiling is done in case any spores fail to become bacteria before the second boiling.

Chloride of lime or rock salt might be used to raise the temperature of the water in the boiler. The former is sometimes used in canning factories, as it gives a very high temperature. A saturated solution of chloride of lime boils at 160° C., or 320 ° F. However, steam under pressure is more generally used, as the temperature can be kept more constant.

There are many preserving powders on the market which make unnecessary the precautions to bring about sterilization. These, however, are dangerous for unskilled people to use. Even when used skillfully, they may produce bad results in children, or other persons who are not in good health, though

the results may not be seen until after years of use. Do not use them yourself and urge others not to use them.

Mistakes in calculating the amount of syrup required for a can of fruit are often made because the space which sugar takes up when it is dissolved is not taken into account.

Experiment 17. To determine how sugar affects the volume of a syrup.

Directions. Take half as much water as the size of the can which you intend to use for fruit. Add half as much sugar as water. Is the volume increased? Heat it just enough to dissolve it. What is the volume? Note any change of volume in each case.

Conclusion. How does a substance dissolved affect the volume of the liquid?

Experiment 18. Canning fruit.

Directions. Can any fruits on the market which are not expensive, using each of the three methods.

a. Compute the cost of fuel and materials and the number of hours of labor.

b. Compare with the cost of an equal quantity of bought canned fruit.

c. How much per hour does it leave for the work?

Experiment 19. Canning tomatoes.

Directions. a. Peel the tomatoes. Cut them into medium sized pieces so that the can may be packed as tight as possible and yet not have the tomatoes like soup when

NOTE. The skins can be most easily removed from peaches, plums, apples, pears, apricots, and quinces as well as from tomatoes by pouring boiling water over them and, if slightly green, allowing them to stand in the hot water for a few minutes.

they are taken out. Mashed tomatoes may be used to fill the empty spaces. Can these by method 2 or 3.

b. To can tomatoes for soup, cook the tomatoes in a saucepan long enough to be able to mash them. Strain them and sterilize the strained portion by any one of the three methods.

c. To preserve tomatoes whole and raw. Use perfect tomatoes with unbroken skins. Wash them and put them into a wide-mouthed jar which has been sterilized. Pour over them boiling water, and put on the lid. These may be used for salad.

Experiment 20. To can corn, beans, or peas.

a. Corn.

Directions. This may be removed from the cob or not. When left on the cob, it is very wasteful of space.

Add 1 t salt to 1 qt of corn. Pack the jar with corn and fill it with water. What method of sterilization will you use?

b. Write out directions for canning beans and peas.

Experiment 21. To can asparagus and string beans.

Write out a method of canning these.

NOTE. Tomato vines may be taken up before frost while the tomatoes on them are still green and allowed to hang in a dry cellar to ripen. This gives fresh tomatoes for many weeks after frost.

NOTE. Experiments by the Department of Agriculture show that the amount of sugar in sweet corn diminishes very rapidly after the ear is pulled from the stalk, even within an hour. This accounts for some of the flavorless corn which is bought.

REFERENCES. "Canning Vegetables in the Home," Farmers' Bulletin, 359, 1909. "Canned Fruits, Preserves and Jellies," Farmers' Bulletin 203, 1905. "Home Manufacture and Use of Unfermented Grape Juice," Farmers' Bulletin 175, 1903. "Preservation of Food," Alice Ravenhill, Bulletin 37, Dept. of Agriculture, Province of British Columbia. "Canning Peaches on the Farm," Farmers' Bulletin 426. "Swells in Canned Vegetables," Farmers' Bulletin 73, Experiment Station, Work IV, pp. 30-31.

CHAPTER VI

PRESERVING, JELLY MAKING, AND PICKLING

Preserving

Preserved fruit differs from canned fruit in the thickness of the syrup used.

Use from ¼ to ½ as much sugar as fruit. With juicy fruits no water is required. For hard fruits, use ¼ as much water as fruit and ½ as much sugar as fruit.

For peaches, sweet plums, soft pears, and pineapples use water enough to a little more than cover the bottom of the pan, and from ⅓ to ½ as much sugar as fruit, depending upon the sourness.

Use a wooden spoon and avoid burning. Fruit should be cooked until it is tender and until the syrup is of the desired consistency. Sugar acts as a preservative or antiseptic; the greater the proportion of sugar the fewer the possibilities for bacteria to grow. It has not so much of a preservative effect against molds and yeasts, therefore, precautions must be taken to keep them out. The jars should be sterilized and some air proof material should cover the top.

Jelly Making

An ideal fruit jelly is a beautifully colored, transparent, palatable product of such a texture that the mass quivers but does not flow when taken from a glass. It is so tender that it cuts easily with a spoon, and yet so firm that the faces of the cut retain their shape. It must not be syrupy, or gummy, or sticky, or tough. To produce such a jelly requires an understanding of:

I. The Constituents of Fruit Juice

Water	Pectin
Acids	Sugars

Flavoring materials

Without pectin no fruit juice can be made into jelly. If pectin is present it may be seen by adding from 1 to 2 T of cooked juice to the same quantity of absolute alcohol, mixing the two thoroughly and cooling. Pectin appears as a gelatinous mass which may be taken out on a spoon. The cooked juice of fruit shows much more pectin than the raw juice.

Different fruits contain different quantities of pectin. The amount of this which a fruit contains determines the amount of jelly which may be made from its juice.

Not only pectin, but acid, is necessary to make

Note. The white skin of oranges and lemons contains much pectin. It may be added to fruits low in that constituent.

jelly from fruit juice. Quinces, pears, peaches, sweet apples, strawberries, etc., contain plenty of pectin, but are lacking in acid. With juices from these fruits a more acid juice or a little powdered tartaric or citric acid may be used. These acids come from grapes and lemons. In most cases the original delicate flavor of the fruit is changed somewhat by the addition of acid; an improvement is found though in the case of sweet apples and quinces. The amount of acid to be used must be decided by taste. Begin by adding 1 t of powdered acid to 1 qt of juice. Bring the tartness of the juice to that of a good tart apple.

II. The Method of Making Extractions of Fruit Juice

1. The first extraction.

a. Very juicy fruits, such as currants and other berries, should have added to the kettle in which they are to be cooked just enough water to prevent burning. Cover the kettle and let the fruit cook slowly, stirring occasionally with a wooden or silver spoon. When the simmering point is reached, crush the fruit with a wooden masher, then continue heating until the whole mass is cooked. Now pour this into a jelly bag (flannelette is a good material) which has been rung out of hot water. Let the juice drain through this into an earthen or enameled pan. Do not squeeze the pulp.

2. When the juice is fairly well drained, put the pulp into a kettle again, and cover with cold water. Bring this slowly to boiling and drain again. Use the alcohol test to determine the amount of pectin in this second extraction. If the

gelatinous mass is heavy, a third extraction may be made. Sometimes there may be enough pectin to allow five extractions, but ordinarily only three can be made.

b. Less juicy fruits. If juice is to be extracted from such fruits as apples and quinces, clean the fruit and cut it into small pieces, skins, and seeds included, and cover with water. From here on proceed just as in using juicy fruits.

III. The Amount of Juice to be Cooked at One Time

With the present knowledge of jelly making, it seems wise to use not more than 2 qts of juice at once. The whole process should be carried out as quickly as possible, since long, slow cooking changes the pectin into substances which have no jelly making power. Currant jelly, first extraction, has been made in ten minutes; apples may need thirty minutes.

IV. Proportion of Sugar to be Used

A wrong proportion of sugar is one of the most frequent causes of poor jelly. The results of experiments using the same volume of juice and different proportions of sugar

Plate 4.—Showing the effect of different proportions of sugar on the consistency of currant jelly. (Courtesy of the University of Illinois.)
1. Ratio of juice to sugar. (1) 4 :3, (5) 1 :1, (6) 8 :9.

will show the effect of sugar. In the following table 1 : $\frac{1}{4}$, for example, means 1 volume (that is, 1 c, 1 pt, etc.) of juice, and $\frac{1}{4}$ that volume of sugar.

Juice		*Sugar*	
1	:	0	Quantity of jelly very small, tough, opaque, unpalatable mass, consisting chiefly of the pectin in the juice.
1	:	1/4	Greater quantity jelly; less opaque, still tough.
1	:	1/2	Still greater quantity jelly. More transparent and tender.

Using 1/2 c currant juice, the following results were obtained:

1 : 3/4 gives 5 T of jelly—flavor a trifle too sour; texture good.

1 : 1 gives 6 T of jelly—flavor excellent; texture excellent.

1 : 1 1/4 gives 9 T of jelly—flavor too sweet; mass not firm enough.

Summary. There is a certain proportion of sugar for each juice, with which an ideal jelly can be made. As the proportion of sugar is decreased, the toughness of the jelly is increased. As the proportion of sugar increases beyond this perfect one, the jelly produced becomes increasingly soft until it is only a syrup. Cooking will not make anything but a gummy mass of it. See plate 4. The only remedy is to boil this product with more juice to furnish pectin enough to take care of the over proportion of sugar.

For the first extraction of the juices of currants and grapes which are a little underripe, a proportion of 1 : 1 has been found best. However, if these fruits seem unusually watery, and do not show sufficient pectin, decrease to 1 : 3/4.

For the first extraction from raspberries and blackberries, and from juices of fruits for which water to cover was used in cooking, 1 : 3/4 has been found to be generally the best proportion. This should also be decreased if the pectin test is not good.

For the second and third extraction. Boil these together, if the quantity is not too great, until they have lost enough water so that by taste and pectin test they are approximately like first extraction. Then use the same proportion of sugar.

V. Time to Add Sugar

It has been found that the best time for putting the sugar into the juice is when the boiling (after draining) is about half done; that is, after 5 minutes for currants and after 10 to 15 minutes for apples. Some heat the sugar before adding it, in order not to cool the juice so much.

VI. Jelly Test

Some work is being done to determine the temperature which will indicate when jelly is cooked just long enough. So far, this is not completed, and we must rely on the spoon test. When a drop of juice does not run off, but falls off the stirring spoon, another drop seeming to join the one ahead before it falls, the jelly is done. The old method of allowing some of the juice to cool on a plate to see if the jellying point has been reached, takes too much time. No time should be lost in taking the jelly from the fire when the right point has been reached.

VII. Care of Jelly

Since jelly is very sweet, it is not likely to be spoiled by bacteria. Sometimes yeasts act upon it and make it taste like wine. How may this flavor be done away with? The chief agents in the spoiling of jelly are molds. In order to prevent their growth, the jelly should be poured into a sterilized jar while it is hot. Before pouring the jelly into the glasses, pour into them enough melted paraffin to cover the top of the jelly. Pour the hot jelly on top of this and the

paraffin will rise to the top and cover the surface. Sometimes jelly is placed in the sun for a few hours if it does not seem stiff enough. In this case the paraffin could not be put into the glass first satisfactorily. The paraffin, however, prevents any chance for infection of the jelly by yeasts or molds, and is easily used after one has had a little experience in jelly making. Lids should then be put on. With these precautions, jelly may be kept anywhere without danger of spoiling.

Experiment 22. Prepare jelly from any fruit to be had. Calculate the cost and compare it with that of bought jelly.

Pickling

Pickling means preservation by means of salt, vinegar, and spices.

Two undesirable changes are likely to occur in pickling. First, the fruit is likely to shrivel. Second, in the case of cucumbers, it may become soft.

Experiment 23. To explain shriveling, perform the following experiment.

Directions. *a.* Put pieces of an uncooked vegetable, potato, beet, or cucumber into weak salt water, 1 part salt, 8 parts water. Allow them to stand for one-half hour.

b. Repeat, using pieces of cooked vegetable.

c. Repeat, putting pieces into plain water.

d. Put pieces from *a* into plain water. Let stand one-half hour.

e. Put pieces of *c* into salt water.

Conclusions. 1. What conditions produce shriveling?

2. How may it be remedied?

REFERENCES. *Principles of Jelly Making,* N. E. Goldthwaite, University of Illinois, Urbana, Ill.

3. How does cooked vegetable differ from raw in shriveling?

The effects which have been noticed in this experiment have been brought about by osmosis, an exchange of liquids through the cell walls.

Experiment 24. To prepare unripe cucumber pickles.

Directions. Put 4 qts small cucumbers in brine composed of 1 c salt, 2 qts water. Let stand 3 days. Drain off the brine, boil it, and pour over the cucumbers again. Let stand 3 days, then drain off the brine, and pour over the cucumbers 1 gallon of boiling water in which 1 T of alum has been dissolved. Let stand for six hours, then drain off the alum water. Next, boil the cucumbers for 10 minutes, a few at a time, in one-fourth of the following mixture. Strain the remaining mixture over the pickles in the jars.

1 gal. vinegar	4 red peppers
2 T allspice berries	2 T cloves

Questions. Softening is due to bacterial decomposition.

1. What precautions are recommended in the above recipe to prevent this?

2. By what micro-organisms are these cucumbers likely to be affected after they are perfectly cooked? How prevent their action?

Experiment 25. To prepare Chili Sauce.

12 medium tomatoes	1 T salt
1 pepper	2 t cloves
1 onion	2 T cinnamon
2 c vinegar	2 T allspice
3 T sugar	2 t nutmeg

Cook $2\frac{1}{2}$ hours

REFERENCE. Reynolds Green, "Vegetable Physiology," (for teacher.)

Question. What precautions must be taken to keep this from spoiling?

Vinegar. This is made from any one of several solutions containing sugars by the changing of alcohol to acetic acid by bacteria. The pure food regulations require 4% of acetic acid to be present. The soft mass often found in the bottom of a vinegar vessel called "mother of vinegar" is an accumulation of the bacteria which formed the acid. If the vinegar is clear when it is bought, no mother should appear in it, providing 4% acid is present, since this degree of acidity prevents further growth of the bacteria.

The following kinds of vinegar are in common use:

1. *Cider Vinegar.* Made from cider. Considered best in United States.

2. *Wine Vinegar.* Made from wine in wine-producing countries, but the wine vinegar of this country is made from dilute alcohol.

3. *Malt Vinegar.* Used in England where neither cider nor wine is made. It is made from grains.

4. *Molasses Vinegar.* Made from fermented molasses, and largely used in the United States. It is made to imitate cider vinegar and is frequently sold under that name.

5. *Spirit Vinegar.* Made from dilute alcohol. The chief adulterations practiced in this country are dilution with water and coloring to imitate cider vinegar.

Dried Fruit

Experiment 26. To determine the best method of preparing dried fruit for serving.

Wash and use either 3 prunes, 6 dried apricots, or 2 dried peaches.

a. Weigh the fruit and soak it over night in enough water to cover it. Cook it until tender in the water in which it

has soaked. Take the fruit out of the juice. Note the time for cooking and the weight. Put the fruit back into the juice, sweeten and, in the case of prunes, add a little lemon juice.

b. Wash and weigh the fruit. Cover it with water and cook it until it is tender. Note time for cooking and weigh as in *a.* Convert into fruit whip.

Conclusions. Compare the two methods of cooking as to (1) time, (2) texture.

FRUIT WHIP

¼ c fruit pulp	White of 1 egg
Sugar	Few grains salt

Few drops of lemon juice

Beat the egg until stiff. Fold in the fruit pulp and enough sugar to give the right sweetness. A few drops of lemon juice improves the flavor, especially if prunes are used. Chill before serving.

CHAPTER VI

STIMULANTS

BEVERAGES—SPICES

Tea. Tea is made from the leaves of a small tree from three to six feet high which grows chiefly in China, Japan, and Ceylon. Four sets of shoots are sent out by the plant each year. The two small leaves at the tip of a young shoot are the most juicy and contain the least fiber. These make the best tea, the real Flowery and Orange Pekoe. The larger leaves further down the stem make the Pekoe, Souchong, and Congo, inferior in flavor to that made from the smaller leaves. Young Hyson tea is made from leaves corresponding in size to Souchong; Gunpowder tea comes from leaves like the Congou. These are green teas.

Preparation for Market. There are two methods of preparing leaves.

1. *Black tea.* For this the leaves are withered in the sun, then rolled until they become soft and mushy, then made into balls and allowed to ferment. When the fermentation is complete, they are dried in the sun and then in a furnace.

2. *Green tea.* This differs from black tea chiefly in its not being allowed to ferment before being dried. Formerly green tea was made as black tea was, then treated with chemicals to give proper color. This is rarely done now.

By fermentation black tea has one of its harmful constituents, tannin, made less harmful, less capable of being dissolved in the digestive juices. For this reason it is less injurious than green tea. Black tea has a little more stimulant, theine, than green tea.

	Green Tea	*Black Tea*
Tannin	10.64%	4.89%
Theine	3.20%	3.30%

The flavor of tea is due to the oils which it contains, and in some cases to the material which has been used to scent it, for instance, fragrant olive. Teas from different countries have different flavors. To make the best flavor and body and pungency, most teas on the market are blends of many varieties.

Preparation of the Beverage. The method of making tea is far more important and possible to control than the variety. Allowing boiling water to stand on the leaves is called making an infusion. The Chinese directions for making tea require that the water shall be freshly boiling, not having all the air driven out, and be poured on the leaves while it is boiling, for only at that temperature can the best flavors be extracted. This means that the vessel in which the water is poured must be heated so as not to lower the temperature of the boiling water.

Standards for Judging. Tea-tasters say that the infusion should be of reddish-golden color, pungent in flavor, and not hard or thin, but soft and mellow.

The leaves should all be of a bright coppery tint, and not completely unrolled at the end of the infusion. There should be few stems. The length of time of the infusion determines the amount of tannin and theine extracted and, therefore, the effect of the tea on the body.

Tea and coffee are not related in composition to fruits and vegetables. They follow the subject of *Canning* because of the simplicity of their preparation, the chief points being the regulation of temperature and time.

Tea and coffee, although they contain some protein and carbohydrate, are yet in no sense foods, because these substances are in minute quantities and not capable of being dissolved and used by the body. Chocolate and cocoa are foods and on this account will be studied with starchy foods.

All four of these are *stimulants.* This means that they act as spurs to increase mental and physical alertness. They should not be used by children and only in moderate amounts by adults. The stimulants which they contain are not equally strong. Many adults do not notice any stimulation from cocoa or chocolate, although it can often be noticed in children after the eating of chocolate candy. The stimulant in tea is called theine, in coffee, caffein, in chocolate and cocoa, theobromine.

Tea, in particular, contains another harmful substance, tannin. The amount of this substance in

an infusion of tea depends upon the length of time which the leaves are allowed to stand in the water. Tannin in small quantities interferes with the secretion of the digestive juices and with the digestion of protein.

Experiment 28. To determine the amount of tannin extracted by different methods of making tea.

Directions. a. Weigh four 1-gram portions of black tea. What part of a teaspoon is one gram of tea?

1. Pour ½ c boiling water upon 1 gram tea. Keep it hot and let it steep 1 minute. Drain from the leaves. Taste.
2. Pour ½ c boiling water upon 1 gram tea. Keep hot. Let steep 3 minutes. Taste.
3. Pour ½ c boiling water upon 1 gram tea. Keep hot. Let steep 5 minutes. Taste.
4. Pour ½ c boiling water upon 1 gram tea. Keep hot. Let boil 1 minute. Taste.

Put 10 cc from each cup of tea into test tubes. Test for tannin (see test given below). Save tests to compare with those from green tea.

b. Repeat *a* in all parts using a green tea.

Test for Tannin with Cupric Acetate

Make a saturated solution of cupric acetate by boiling 1 gram of cupric acetate in 50 cc of water. To 10 cc of the solution add 15 drops of the cupric acetate solution. Boil. Solid material, called precipitate, forms. This is the tannin. It does not show immediately, however. Let the test stand for 24 hours.

NOTE. Ferrous sulphate solution in the proportion of ½ cc to 5 cc of tea solution may be used in place of cupric acetate, but does not give so clear a test and it will not precipitate tannin from coffee.

Conclusions. 1. Which method gives the best flavor to the tea?

2. Compare the amounts of tannin obtained from each method.

3. Compare the amounts of tannin obtained from green and from black tea.

4. Write a recipe for making tea, indicating amount, kind, temperature, and time.

Question. How do these samples compare with the tea-tasters' standards?

Coffee. The grains of coffee which we know are the seeds of a berry resembling a small cherry. This grows in the tropics on trees six to ten feet high. The pulp is dried and removed, then the seeds are cleaned, dried, and roasted. There are three kinds of coffee in general use: Mocha, Java, and Rio or Brazil. They take this order in regard to price and desirability.

The tannin in coffee is combined with the caffein. These in roasted coffee are 1.24%, in comparison with 3.20% theine, and 10.64% tannin in tea. This seems like much less of the harmful constituents than are found in tea, but the greater quantity of coffee used to 1 c water a little more than counterbalances this, so that from about 1 quart of tea or 3 cups of coffee it has been estimated one gets the amount of theine or caffein which is given as the smallest dose when administered as medicine.

REFERENCES. Snyder, "Human Foods," pp. 203-206. Hutchison, "Foods and Dietetics," pp. 300-308, 1902 edition.

Whole coffee is rarely adulterated now. There is, however, substitution of cheaper brands for choice kinds. Ground coffee is more frequently adulterated with such things as roasted peas, beans, cereals, chicory, etc. These are ordinarily heavier than coffee and therefore, if the suspected material is shaken in cold water, the coffee will be found at the surface, the adulteration at the bottom. Coffee substitutes are made of roasted wheat, or peas, or these combined, and, many times, chicory. Some contain coffee itself which may be considered an adulterant in this case.

Standards for Judging Coffee. Good coffee should have a yellow tinge when cream is added to it. It should have a mellow, yet pungent flavor with a good body to it, that is, it should not taste thin.

Experiment 29. To determine the effect of hot water upon the amount of tannin extracted from coffee.

Directions. *a.* Tie coffee loose in a piece of cheesecloth, using the proportion of 2 T coffee to 1 c water, and making ½ c coffee in each case.

1. By placing coffee in cold water and bringing it slowly to the boiling point. Taste while hot, adding sugar and cream if desired.
2. By placing coffee in cold water, heating slowly, and removing just before the boiling point is reached. Taste.
3. By placing coffee in boiling water and boiling for 5 minutes. Taste.

Remove 10 cc from each solution and test for tannin as in tea.

Conclusions. 1. What are the differences in the flavor of the coffee due to differences in method of preparing it? Which method gives best flavor?

2. Compare the amounts of tannin obtained by different methods of preparing coffee.

3. Compare amounts of tannin found in 1 c tea and 1 c coffee.

b. Make a cup of coffee for serving, using the temperature and time which you found best in *a*, but do not put the coffee in cheesecloth. Clear it:

1. By mixing coffee with egg and cold water.
2. By adding 1 T of cold water to settle.
3. Compare these with the best coffee of *a*.

Conclusion. What is the best method of clearing coffee?

Questions. 1. How should a cup of coffee look: (*a*) Before adding cream? (*b*) After adding cream?

2. Why does egg settle coffee?

3. Why does cold water settle coffee?

NOTE. In Europe coffee is made strong and used with equal parts of hot milk. This is called "café au lait."

REFERENCES. Snyder, *Human Foods,* pp. 207-210. Hutchison, *Food and Dietetics,* pp. 308-311.

Spices

1. *Peppers, white and black.* Fruit of pepper plant, a perennial shrub growing in the East and West Indies. a. black—berry picked before thoroughly ripe. b. white—berry picked when mature; this has the hull all removed.

2. *Red or Cayenne pepper.* Fruit pod of capsicum, found mainly in the tropics.

3. *Mustard.* Seed of mustard plant. Brown or black mustard has smallest seed and most aroma. White mustard frequently unground. Only the inner part of the seed is used for ground mustard.

4. *Ginger.* The root of a seed-like plant, a native of Southern Asia. Jamaica ginger is the best variety.

5. *Cinnamon and cassia.* The bark of several species of tropical plants. True cinnamon is a native of Ceylon; the cassias are from Bengal and China. The former has much thinner bark than the latter, and is rarely found except in drug stores; by far more cassia is used in this country.

6. *Cloves.* Dried flower buds of a tropical evergreen.

7. *Allspice.* The fruit of a West Indian evergreen tree. A small, dry berry, two-celled, each cell having a single seed.

8. *Nutmeg.* Interior kernel of an East Indian tree. Fruit resembles a small pear. The fleshy crimson mantle covering the seed is mace. The white dust on nutmeg is lime, used to prevent the sprouting of the germ.

REFERENCE. Snyder, "Human Foods."

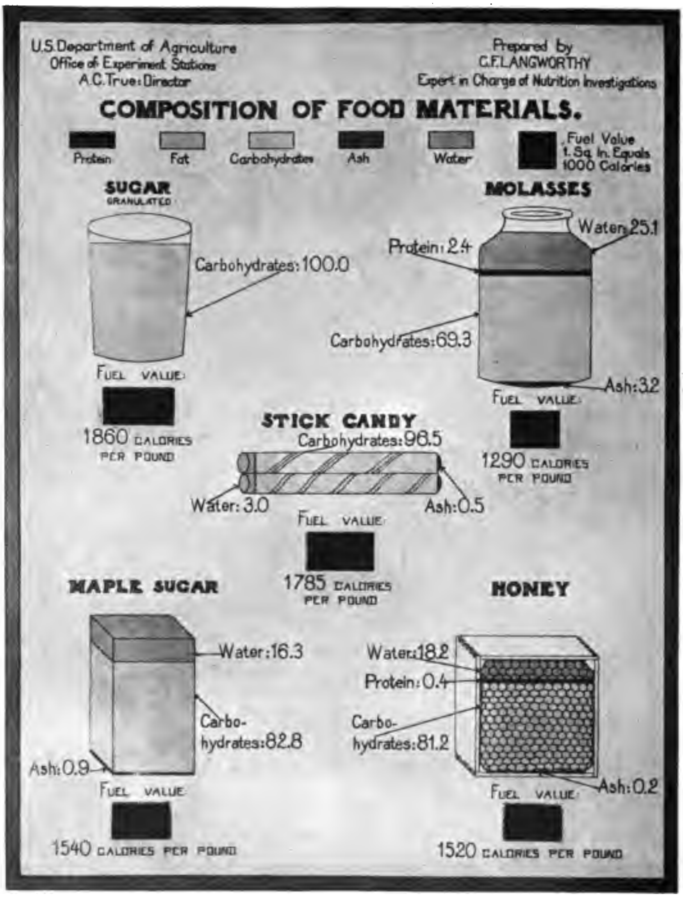

U.S. Department of Agriculture
Office of Experiment Stations
A.C. True: Director
Prepared by
C.F. LANGWORTHY
Expert in Charge of Nutrition Investigations
COMPOSITION OF FOOD MATERIALS.
Protein
Fat
Carbohydrates
Ash
Water
Fuel Value 1 Sq. In. Equals 1000 Calories
SUGAR
GRANULATED
Carbohydrates: 100.0
FUEL VALUE
1860 CALORIES PER POUND
MOLASSES
Protein: 2.4
Water: 25.1
Carbohydrates: 69.3
Ash: 3.2
FUEL VALUE
1290 CALORIES PER POUND
STICK CANDY
Carbohydrates: 96.5
Water: 3.0
Ash: 0.5
FUEL VALUE
1785 CALORIES PER POUND
MAPLE SUGAR
Water: 16.3
Carbo-hydrates: 82.8
Ash: 0.9
FUEL VALUE
1540 CALORIES PER POUND
HONEY
Water: 18.2
Protein: 0.4
Carbo-hydrates: 81.2
Ash: 0.2
FUEL VALUE
1520 CALORIES PER POUND

Plate 5.

CHAPTER VIII

CARBOHYDRATES

SUGAR—CANDY—STARCH

The carbohydrates with which we are best acquainted are sugar and starch. The newspapers had much to say about glucose (also a carbohydrate) in candies a few years ago, but many people have never seen it to recognize it.

Green plants are the original makers of all the carbohydrates which we use as food, except milk sugar. They take in through their leaves carbon dioxide, a waste product of animal and plant breathing, a product of decomposition and of burning. Through their roots they take water from the soil. In the presence of sunlight and chlorophyl, the green coloring matter in the plant, they make this water and carbon dioxide into a glucose sugar. This is the form of carbohydrate which the plant uses as food. When it has made all of this that it needs for food immediately, it does not stop. It begins to put glucose sugar into the more compact forms of sugar and starch, by taking away from the glucose sugar more and more water. In these forms the plant stores carbohydrates in seeds, roots, or tubers. Should the plant need some of this stored material as food, as for instance, in sprouting time, water is

added, and starch and sugar become a glucose sugar again. All of these changes in the amount of water, and consequently, in the kind of carbohydrate, are brought about by enzymes in the plant.

There are several members of these three different groups of carbohydrates which are commonly found in foods, as follows:

Glucose or Monosaccharid Group	*Cane Sugar or Disaccharid Group*	*Starch or Polysaccharid Group*
Glucose or dextrose	Sugar or sucrose	Starch
Fructose or levulose	Milk sugar or lactose	Dextrin
Galactose	Malt sugar or maltose	Cellulose
		Glycogen
		Pectin

NOTE FOR STUDENTS WHO HAVE HAD CHEMISTRY. Formula for Monosaccharid group, $C_6H_{12}O_6$. Formula for Disaccharid group, $C_{12}H_{22}O_{11}$. Formula for Polysaccharid group, $(C_6H_{10}O_5)_n$.

To be able to select carbohydrates intelligently in regard to their ease of digestion and cheapness, we must understand what kinds of carbohydrates the different foods contain and the changes made in them by cooking and digestion. To do this the characteristic of this food nutrient and color tests for it are given.

SOURCES AND CHARACTERISTICS OF CARBOHYDRATES WHICH ARE FOUND IN FOODS

Glucose or Dextrose—Where Found. 1. In ripe or sprouting fruits or vegetables, in honey and in the yellowish grains in raisins.

2. In syrups made from corn and potato starch by action of an acid. Example: corn syrups; it is about 40% of these. If the acid acts longer, solid, almost pure dextrose is formed.

3. In the digestive tract and in the blood as the result of the action of the digestive juices on sugars and starches.

4. In juices of cooked fruits by action of acid in fruit on sugar used for sweetening.

Characteristics. 1. Crystallizes fairly easily.

2. Dissolves in water easily.

3. Is less sweet than sugar.

4. Gives orange or brick color with Fehling's solution.

Fructose or Levulose—Where Found. 1. As companion of glucose in fruits, vegetables and honey.

2. In digestive tract from digestion of sugar, not from starch.

3. In the juices of stewed fruits. It is formed as in glucose from the action of fruit acid on sugar.

Characteristics. 1. Does not crystallize easily.

2. Is sweeter than cane sugar.

3. Gives Fehling's test.

Sugar or Sucrose—Where Found. 1. In stems and roots of sugar cane, beets, sorghum, cornstalks, carrots, turnips, old potatoes.

2. In the sap of date palm and sugar maple trees.

3. In fruits and in the nectar of flowers.

Common sugar is manufactured (in about equal quantities) from either sugar cane or sugar beets. Tests show that well purified sugars from these two sources are equally valuable and no difference can be noted if the crystals are equally fine. Only in the last seventy-five years has sugar been produced in

such quantities as to bring it into general use. In the United States 81.6 pounds per person were consumed in 1910. The English speaking people use more than any other.

Characteristics. 1. Forms large crystals easily.

2. Dissolves readily in water.

3. Does not give Fehling's test.

Maple sugar and syrup have other substances in them which give the special flavor. See plate 5. The amount of sugar in maple sap is small; five gallons must be boiled down to make one pound of sugar. In spite of this, millions of pounds of maple sugar and syrup are produced yearly in the United States.

Malt Sugar or Maltose—Where Found. 1. During the digestion of starch in the animal body.

2. In plants as ripening goes on and starch changes to glucose.

3. In syrups made from starch and acid.

4. In malt extracts used in the preparation of some breakfast foods, and in some medicines.

Characteristics. 1. Gives Fehling's test after a few seconds of heating.

Milk Sugar or Lactose—Where Found. 1. In milk.

Characteristics. 1. Less sweet than any other sugar. It is used in medicine as a basis for many powders and pellets.

Milk sugar or lactose is the form in which sugar is found in milk and is much less sweet than sucrose. The grains of the cane sugar group are much larger and more readily formed than those of the glucose group.

Starch is a white substance, without crystals, which is found in fruits, in vegetables, and in cereals. *Dextrin* is produced when starch is browned by heat, when the plant changes starch back into sugar, or as the first product of starch digestion in the body. *Glycogen* is the form in which starch is stored in the liver and muscles. *Cellulose* is the material which forms the framework of a plant, being soft when the plant is young, and tough and woody when the plant is older. It forms wood of trees and the bast of cotton fibre. *Pectin* is one of the substances on which the jelly making power of fruit depends.

Sugars. To understand the relationship of one group of sugars to another we must have some method of distinguishing them. The following experiments show this:

Experiment 30. To determine a method of detecting the presence of a glucose sugar.

Directions. *a.* Add to a little glucose in a test tube a little Fehling's solution. Heat. An orange or red color indicates the presence of a glucose sugar. Maltose and lactose also give an orange color with Fehling's solution, but a few seconds or a minute of boiling is required before the color shows when these alone are present.

b. Test cane sugar in the same way.

Experiment 31. To determine a method of detecting the presence of cane sugar.

Directions. To a little cane sugar in 1/4 test tube of water, add 2 or 3 drops of vinegar. Boil, then add Fehling's solution and heat.

Conclusion. How may the presence of cane sugar in a substance be detected? What has the acid done to the sugar?

In the making of candies, the changing of cane sugar to dextrose and levulose by acid is made use of to increase the smoothness. All of the varieties of fondant, fudge, penocha, etc., to be considered any more than sweet and edible, must be of just the proper softness and of so smooth a texture that they feel almost like cream or butter to the tongue.

The thickness of the syrup, that is, the temperature and time of cooking determines the hardness; the number and size of crystals determine the smoothness. By noting the characteristics of the crystals of cane sugar as compared with those of the glucose sugars it is easily seen which are more desirable in candy.

NOTE. Fehling's solution added to any other substance except a glucose sugar or maltose or lactose will not give the orange or red color, therefore, whenever that color is given with that solution one of these sugars must be present. Likewise iodine gives the blue color only with starch, consequently, the blue color with iodine is a test to find out whether starch is present in a substance or not. These are called color tests for the presence of carbohydrates.

TO TEACHERS. To make Fehling's solution use:

(1) 9 grams $CuSo_4$ + 250 cc H_2O.

(2) 30 grams NaOH + 250 cc H_2O.

(3) 43 grams Rochelle salts + 250 cc H_2O.

To use. Add to equal parts of 1, 2, and 3 twice that volume of water.

The temperatures of syrups given throughout the work on sugar are sea level temperatures and should be altered according to the altitude.

Experiment 32. To determine by means of cold water the tests of syrups used for different purposes.

Directions. Use 1 c of sugar and 1/4 c of water. Take out a little syrup on a spoon at temperatures given below. Drop it into cold water and, using the fingers, determine the consistency at each temperature. Describe each. Remove the pan from the fire while testing in the water. Use water which is at least as cool as 55° F. for making these tests.

1. Boiling point of syrup used for fondant, 112° to 114° C.
2. Boiling point of syrup used for fudge, 110° to 111° C.
3. Boiling point of syrup used for caramels, 123° C.
4. Boiling point of syrup used for brittle candies, 132° C.

Experiment 33. To make peanut brittle.

Directions. To the syrup remaining in the saucepan, from *Experiment 32,* add not more than half its volume of peanuts. Pour onto an inverted pie tin to cool. Unroasted nuts may be used if they are allowed to cook a few minutes in the syrup. The skins are more difficult to remove from these than from the roasted ones. What is the temperature when the syrup has reached a light brown color?

Sugar may be melted and browned without the addition of water. To do this without burning, requires more skill in stirring and in regulating the heat. No cold water test need be made when this method is used. When the proper shade of brown is seen, the process is finished.

Crystallization. The amount of a substance which a liquid will dissolve depends upon the temperature of the liquid. When the amount of a substance made up of crystals, as sugar, dissolved in water is so great that, at the temperature of the mixture, more

is present than is easily dissolved, crystals of the substance which have been dissolved begin to reappear. This is often seen when too large an amount of sugar has been used in jelly making. When even one crystal is on the side of the vessel so that it comes in contact in any way with the liquid in which the other crystals are dissolved, this one crystal acts as the nucleus or foundation for other crystals. In time the whole mass may become crystals, starting from this one. Stirring, particularly at a high temperature, produces crystallization. Therefore, to make smooth fondant:

1. There must be no crystals on the sides of the pan.

2. Stirring or beating is better done when the mixture is cool.

When cream of tartar is used in fondant or fudge some of the cane sugar becomes dextrose and levulose. Dextrose crystallizes less readily than cane sugar and levulose only with difficulty. This slowness to crystallize prevents graininess, although very smooth candy may be made without cream of tartar, if great care is taken to prevent crystallization. Even when cream of tartar is used, it is best to keep a lid on the pan of boiling syrup, so that that which spatters on the sides does not dry and form crystals. A clean, damp cloth may be used to wipe the sides of the pan.

Experiment 34. To determine the effect of stirring at different temperatures upon the rate of formation of crystals and upon the size of the crystals in fondant.

Directions. a. Boil 1 c sugar with 1/3 as much water to 112° C. or 233° F., or until it forms a soft ball in cold water. Be careful not to spatter sides of pan. While cooking, keep fire low and pan covered, and wipe the sides of the pan with a clean, damp cloth during the process of cooking and before pouring out.

Divide into two parts.

1. Stir while hot.

2. Let stand until cool to the hand, then stir. Note difference in graininess of *1* and *2*. Set aside until next day in a moist place, or wrap in oiled paper so that water does not evaporate. What is the effect, upon the texture, of standing for some hours?

Conclusion. What is the effect of the temperature at which stirring is done upon the texture of fondant?

b. Save a portion of the second one of these. Melt the rest with 1/4 c water, adding 1 ss cream of tartar. Cook and stir in the way which you found best in *a* to prevent crystallization. Keep it over night as in *a*.

Compare, as to texture, with the portion saved from *a*.

Conclusions. 1. What is the effect of cream of tartar upon the sugar?

NOTE. To determine this, test moistened cream of tartar with blue litmus paper. Test vinegar and lemon juice in the same way.

2. Write a proportion and method of making good fondant.

Question. To what is the opaqueness of beaten fondant or pulled taffy due? Compare whitecaps on waves.

Experiment 35. To prepare peppermint patties, chocolate creams and cocoanut bars from the fondant.

a. Cocoanut Bars. Fondant may have soft, shredded cocoanut rolled into it and then be made into bars or other shapes.

b. Peppermint Patties. Melt fondant over hot water and add the flavoring and also coloring matter, if desired. Drop it from a spoon upon an oiled paper to harden.

c. Chocolate Creams. Mold the fondant into the desired shapes and chill it before dipping.

d. Melt chocolate and test it with litmus paper. Moisten brown sugar and test it with litmus paper.

Conclusion. What effect would chocolate have upon sugar in cooking fudge?

Experiment 36. To prepare soft candies such as fudge and penocha.

Directions. a. Use fondant proportions and a little lower temperature (111° C. or 232° F.), and the same precautions to prevent crystallization, add chocolate in proportion of ¾ square to 1 c sugar. Penocha is made with light brown sugar.

Questions. 1. What would you say about the necessity of using milk, cream, and butter in fudge to produce a creamy consistency? 2. Look at the ingredients in the hard

NOTE. The dipping of chocolate creams is done in several ways. The best method is that of melting bitter chocolate, then cooling it as much as possible while still keeping it thin, and then covering the creams. Another method is that of mixing paraffin with the chocolate and having the fondant centers hard so that they may be put into the melted chocolate and paraffin while the latter are fairly hot, without losing their shape. If chocolate is to be melted in order to be used, it should be done over water and the temperature of this water should be below boiling, or else it should not touch the vessel which holds the chocolate. As soon as the temperature of the chocolate is high enough to cook starch, the chocolate begins to thicken.

candies given below. What may be one of the reasons for their not being grainy?

Experiment 37. To prepare hard candies such as butter scotch and toffee.

Taffy. This is a fondant cooked to the brittle stage, with the addition of butter and any flavoring desired. If desired, a light syrup may be used in the proportion of 1/4 part syrup to one part of sugar.

BUTTER SCOTCH

1 c sugar	2 T butter
1/4 c corn syrup or molasses	2 T mild vinegar or 2 T lemon juice
1/4 c water	

TOFFEE

1 c light brown sugar	2 T vinegar or juice of 1/2 lemon
2 T butter	

Cook all materials together to 132° C., 269 3/5° F., or until brittle in cold water. Pour onto buttered plate and, when slightly cool, dent. Crack when cold. Why is it possible to stir this without fear of crystallization?

The Use of Sugar and Candy in the Diet

Adulteration. There is a popular belief that sugar is often adulterated with starch or lime dust. Hundreds of tests have failed to show this to be well-founded.

Value in the Body. Sugar, like starch and other carbohydrates and fats, furnishes the body with

REFERENCE. *Principles of Candy Making*, by Louise Stanley, Missouri State Board of Agriculture, 1911.

fuel for heat or work. Since it has only one change; *i.e.*, to glucose and levulose, to make before it is ready for absorption into the blood stream, its effects in case of fatigue or starvation may be felt in one-half hour. It and sweet chocolate are carried by mountain climbers. Sugar is given in army rations much more than formerly, and tests show less fatigue in the soldiers after long marching. Lemonade or other sweet refreshing drinks are often given between meals to harvest laborers who are doing heavy, muscular work. Sugar is now given at athletic training tables, where it was once prohibited.

When sugar is eaten in too large quantities at once and in a concentrated form, it produces a burning, dry sensation in the mucous lining of the mouth and stomach, or other digestive disturbances. It seems that about 1/4 lb per day may be easily used by the body.

Sugar and starch when eaten in excess of the body's need for fuel are stored largely as fat. Therefore they should not be indulged in by portly people.

Time for Eating Sweets. When sugar or candy is eaten between meals, or in any way that leaves no appetite for other food, it is injurious. It is thought best to put little or no sugar on cereals for children, lest in their fondness for sugar, they become satisfied before the cereal itself is eaten. Sugar alone

cannot furnish the nutrients to build a strong body; it has no protein or ash. Lump sugar and candy may be given in small quantities at the end of meals or several hours before a meal, when they do not interfere with normal appetites. The fondness of children for sweets is probably due to the energy they supply for their great activity. The amount of sugar eaten by the individual must be governed by the muscular exercise. A day laborer could eat, with good results, an amount that would be harmful to a clerk or stenographer.

Sugar and the Teeth. When the teeth are not kept clean, any food particles which cling to them are decayed by bacteria which are present in every mouth. When sugar or other substance decays it forms an acid which destroys the enamel that protects the teeth. Therefore, it seems unfair to lay the blame for decayed teeth upon sugar alone. If not kept clean the teeth would undoubtedly decay, even though there were no sugar in the diet.

The Selection of Candy. Much cheap candy, colored with harmful dyes and handled in a dirty way, exposed to the street air or displayed on counters, handled by dirty hands and weighed in dirty scales, is bought by and for children. Although much improvement has been made in this regard, a better plan is to make taffy, butter scotch or peanut brittle at home.

Hard candy should not be broken by the teeth

but should be allowed to melt in the mouth. An observance of this rule would prevent many broken corners, which are the beginnings of decayed teeth.

Chocolate candy should not be given to children in any considerable quantities. The theobromine in the chocolate is too strong a stimulant for their delicate nervous systems.

REFERENCE. "Sugar and Its Value as Food," Farmers' Bulletin 535, 1913.

CHAPTER IX

FREEZING MIXTURES

ICES—ICE CREAMS

This subject involves so many principles that it might logically be considered in any one of several places. Since syrups or sugar and cream or milk are used in the making of all frozen preparations, it may follow candy-making. We must consider the subject of temperature of water with substances dissolved in it without the application of heat.

In order to understand how to make an ice cream or a fruit ice so that it is hard and smooth one must understand the difference between freezing water and freezing a syrup or sweetened cream, and the use of salt and ice to do this. Water freezes when it loses enough heat to change it to a solid; that is, at 0° C. or 32° F. Substances which will dissolve in water lower the temperature at which it freezes in proportion to the amount of the substance dissolved. Thus, ice creams or ices which contain sugar freeze at —6° C. to —8° C. or 22° F. to 17° F.

Ice melts at 0° C. or 32° F. Eighty calories of heat are required to change ice to water without changing its temperature. The use of this amount of heat by the ice in melting does not take away

enough heat from the mixture to be frozen to freeze it. Therefore, by the use of ice alone ice creams and ices can not be frozen.

If a handful of salt be put into some water at 60° F. or 15° C. the temperature of the water will fall several degrees. This means that some of the heat of that water has been used up in dissolving the salt. Likewise, to dissolve salt in the melting ice uses up some heat from the mixture to be frozen. This plus that used in melting the ice makes a temperature below freezing point in the freezing mixture and also in the mixture to be frozen.

The lowest temperature which can be reached with salt and ice is —22° C. or —7⅗° F. At this temperature the water has dissolved all the salt possible. Therefore, it does no good to add more salt, since only that dissolved affects the temperature. From the above facts it will be seen that the melted ice and salt has a lower temperature than the unmelted ice and salt. This low temperature of the water is maintained until most of the ice is melted. After this the temperature rises gradually.

Construction of a Freezer. Freezing depends upon two conditions. First, the heat to melt the ice must be taken from the mixture to be frozen, rather than from the outside air. Second, the mixture to be frozen must be frozen evenly, not one part very hard and another part merely congealed. Materials carry heat with different degrees of conductivity,

by passing it from one particle in the substance to the next. The rate at which it is carried differs with different substances. Metals are the best conductors of heat and of these silver and copper stand first. Stone, brick, and glass are inferior to metal. Still poorer are wood, cork, hay, paper, asbestos, and solids that are loose in structure as wool, feathers, and fur. Gases have practically no conducting power. The quiet air spaces in the loose materials mentioned above are the reason for their poor conductivity. From these facts, explain a freezer and work out a method for using it, answering the following questions:

1. How fine should the ice be?
2. How rapidly should the freezer be turned?
3. What kind of material should be put over the top when packing?
4. How might a freezer be improvised from utensils ordinarily found in a kitchen? How would you manipulate such a one?

Some freezers are now made with a metal instead of a wooden outside pail.

Experiment 38. To determine the temperature which may be obtained by using ice or snow and salt.

Directions. *a.* What is the lowest temperature to be obtained from:

1. Melting ice or snow?
2. A thorough mixture of 20 parts ice to 1 part salt?
3. A thorough mixture of 12 parts ice to 1 part salt?
4. A thorough mixture of 3 parts ice to 1 part salt?

b. Let *1* stand until some of the ice or snow is melted.

Take the temperature of the water now, and a minute or two after all of it is melted.

Conclusion. Explain the results of *1, 2, 3,* and *4.*

Questions. 1. When does the temperature of the melted ice begin to rise?

2. When do you get the lowest temperature in an ice and salt mixture?

3. Should a stopper be used for an ice cream freezer? Why?

4. What is the function of salt in a freezing mixture?

ICES

Experiment 39. To determine the temperature at which water and syrup freeze.

Directions. *a.* Immerse a test tube of water in a mixture of ice and salt (12 to 1). Note the temperature at which it freezes.

b. Make a syrup, using ⅔ c sugar and 1 c water. Bring to the boiling point. Dilute 2 T of this with T of water. Freeze this also and note the temperature.

The length of time which syrup for an ice should be boiled to reach a definite thickness depends upon the amounts of materials used. Small amounts lose water much more rapidly in proportion to their quantity than large ones. The amount of surface exposed in proportion to the volume is much greater in the former. A syrup which has a boiling point of 102° C., 213 3/5° F., diluted with one-half its volume of flavoring and of water, makes an ice of good consistency. Use 2 parts of sugar and 3 parts of water. When this begins to boil its temperature is 102° C.

Questions. 1. What is the volume when ⅔ c of sugar is dissolved in 1 c of water?

If a mixture to be frozen does not freeze, add a little water to it. Explain the reason for this.

Experiment 40. To determine the amount of liquid to be added to the syrup in Experiment 39 b to form an ice of good consistency.

Directions. *a.* Add to the syrup $\frac{1}{4}$ as much flavoring, if lemon juice; $\frac{1}{3}$ as much, if other flavoring, or until it is slightly stronger in taste than you would have it if it were to be eaten at this temperature.

(Why should it be stronger?)

NOTE. Compare the keenness of the sense of touch in cold hands.

Referring to *Experiment 39,* where the syrup was diluted with half its quantity of water, make this syrup of the same dilution by adding what water is necessary after the flavoring. Freeze this. Note the amount of increase in volume. To what is this due?

b. Repeat *a,* adding enough water so that the syrup is diluted with two-thirds of its volume of water and flavoring instead of one-half.

Conclusions. 1. What is the difference in consistency between *a* and *b?* Which do you prefer?

2. Write a recipe for a quart of this ice. (*a*) How many will it serve? (*b*) How much will it cost?

NOTE. Citric acid may be substituted for part of the lemon juice in an ice, thus reducing the expense when the cost of lemons is high. It cannot be used satisfactorily without some lemon juice.

c. Add to a portion of *b,* one-half its quantity of water. Freeze this and note temperature at freezing. Give conclusions as to the reason for the differences in temperature between *a, b, c.*

A sherbet is made like an ice with the addition of the

beaten whites of eggs to the partially frozen mixture or by the addition of a little gelatine to the syrup. Use a proportion of ½ to 1 white of egg to 1 qt of ice or 2 t gelatine to 1 qt. The effect of these ingredients is to give a softer consistency to the ice. The gelatine makes possible the using of a thinner syrup by giving to the ice the proper body to hold air.

Ice Creams. There are two foundations for ice cream, the uncooked and the cooked. In the uncooked, the ingredients are the cream, or milk and cream, sugar and flavoring. The cream may be all cream of whatever richness desired, or it may be as thin as half milk and half cream. If the cream is diluted more than this it loses its smoothness and body. A cooked ice cream should be used when it is desired to use a more dilute cream.

The ingredients of the cooked ice creams are the same as of the uncooked, but a much smaller proportion of cream is used, and egg and flour are added to give it smoothness and the desired body.

The proportions for a vanilla ice cream of both classes are as follows:

Liquid	*Sugar*	*Egg*	*Flour*	*Flavoring*	*Salt*
1. Uncooked 4 c*..	¾ c	.....	....	1½ T	1/16 t
2. Cooked 4 c†....	¾ c	1 yolk	1 T	1½ T	1/16 t

If all milk is used, increase flour to 2 T, and use 2 to 4 yolks of eggs.

* Of this from 1 c to 2 c may be milk and the remainder cream.

† From 1 c to 3 c may be milk and the remainder cream.

1. Uncooked ice cream is made by mixing the ingredients, heating slightly until the sugar is dissolved, then adding flavoring.

2. Cooked ice cream is made by adding the sugar and flour to the heated liquid, cooking for a few minutes to improve the taste of the flour, then pouring this slowly onto the egg yolk. This should then be cooked over a very low fire or over hot water until the mixture begins to have the consistency of cream.

NOTE. Remember that flavorings must be stronger than if the food were to be eaten warm.

VARIATIONS

Chocolate ice cream may be made by the addition of 1½ squares of chocolate to 4 c liquid. This is melted, mixed with some of the sugar and a little water and boiled to a paste before adding to the cream. The sugar should be increased to 1 c for this and for caramel ice cream.

For *Caramel* ice cream, the sugar is melted (as in peanut brittle, second method), and stirred constantly until a golden brown. It may then be added directly to the milk and cream, and this stirred until the syrup is well mixed, or the caramelized sugar may be diluted with a little boiling water before it is added to the cream.

Fruit ice cream is made with from ¼ to ½ as much *crushed* fruit or juice as cream. If the liquid is at all warm, it is better to add the fruit after the cream is partially frozen to prevent the curdling of the cream by the acid of the fruit. The sugar will have to be changed according to the acidity of the fruit, the amount varying from 1 to 2 cups. Fruit creams, as well as ices, are improved by the addition of a little lemon juice.

Experiment 41. Preparing ice cream.

Directions. Prepare a cooked and an uncooked ice cream.

Questions. 1. What is the cost of (*a*), 1 qt of cooked ice cream? (*b*), 1 qt of uncooked ice cream?

2. What do you estimate to be the difference in time needed to make these two kinds, taking into consideration the dishes used in addition to actual time of preparation?

3. Write a recipe for a fruit ice cream of the cooked and uncooked varieties.

REFERENCES. Millikan and Gale's "Physics," p. 207-210. "Principles and Practice of Ice Cream Making," Bulletin 155, Agriculture Exp. Sta., Burlington, Vt.

CHAPTER X

STARCH

COOKING OF STARCH—COCOA—CHOCOLATE—WHITE SAUCE

In *Chapter VII* we studied how starch is formed by the plant. We are now ready to study some of its characteristics and the effect of cooking upon it.

Starch—Where Found. 1. In most plants.

Characteristics. 1. Odorless, tasteless white powder made up of grains having shapes peculiar to the plant in which they are found.

2. Insoluble in cold water.

3. In hot water, grains become larger and sticky, making a paste.

4. Gives blue color when treated with iodine.

Dextrin—Where Found. 1. Formed by the action of acids or digestive juices on starch.

2. By browning starch.

Characteristics. 1. Less thickening power than starch.

2. Gives a wine color when treated with iodine.

Glycogen—Where Found. 1. The form in which carbohydrate is normally found in the body after absorption in the liver and muscles.

Cellulose—Where Found. 1. It is the cell walls of young plants.

Characteristics. 1. Soft when the plants are young and tender. It is the basis for the laying on of woody cells as the plants grow older.

2. When very young, it is used somewhat as a food by the body, otherwise excreted as waste.

Plants are able by some very sensitive chemical substances which are called enzymes to change starch to glucose. This same result can be obtained by heating starch with an acid.

Experiment 42. To show how glucose may be manufactured from starch.

Directions. *a.* Test ½ ss of starch for glucose.

b. Boil ½ ss starch with 5 drops dilute hydrochloric acid or ½ t of vinegar and a little water for one minute. Test for glucose. Cf. *Exp. 30.*

c. Test starch with a drop of iodine. Note the color.

d. Boil ½ ss starch mixed with water in a test tube, evaporating dish, or beaker with 1 t vinegar for 6 to 8 minutes. Notice the change in appearance. Test a little of it for starch, then test for glucose.

This is the principle upon which commercial glucose is manufactured. It is made in this country from corn by the use of hydrochloric acid, and in Germany from potatoes with sulphuric acid. If glucose is properly manufactured, the acid is removed. It is a cheaper carbohydrate than cane sugar but just as nutritious and wholesome when properly manufactured.

Remember this experiment when making filling for lemon pie, cooked salad dressing, or lemon cornstarch pudding.

The human body as well as plants has enzymes

by which it prepares starch for absorption in the intestines.

Experiment 43. To show the action on starch during digestion.

Directions. *a.* Test a bit of cracker for starch and glucose.

b. Thoroughly masticate a bit of cracker. Remove it from the mouth to a test tube.

1. Take a portion of this in another test tube and test for starch. A deep wine color shows the presence of dextrin, one step toward the digestion of starch. If the saliva is very active, so that all the starch is changed, the dextrin will show.
2. Test the other portion for glucose. If the color does not appear immediately, add a drop of acid, and heat until it appears.

NOTE. If thorough mastication has not taken place more acid will have to be added; that is, in the body this step in digestion must be done in the stomach or intestines. All the starch and sugar must be changed into glucose sugar before they can be absorbed through the walls of the intestines. What is the function of saliva in digestion?

When starch is cooked without an acid, what change takes place to make it more readily digestible? The following experiment will show this.

Experiment 44. To determine by their appearance under the microscope the effect of cooking on starch grains.

Directions. Using a proportion of 1 ss cornstarch to ½ c water.

a. Take out a drop before cooking, place on a slide, stain lightly with iodine, and examine under the microscope.

b. Cook the mixture and take out a drop before it boils. Examine it as in *a.*

c. Boil two minutes and examine as in *a* and *b.*

Make drawings of the grains in *a, b,* and *c,* showing relative sizes of grains and differences of outline.

Conclusions. 1. What is the effect of hot water on a starch grain?

2. What is the difference between *b* and *c*? Explain.

Lumps contain raw starch inside. How to prevent these is one of the important problems in cooking starch.

Experiment 45. To determine the best methods of mixing starch to prevent lump formation.

It is more difficult to mix flour with a liquid without lumping than cornstarch, due to the gluten which flour contains. Flour is about three-fourths starch. Since it is cheaper than cornstarch, use it for making further starch experiments.

Directions. Use 1 t flour and 1/4 c water, unless another amount is called for.

a. Solve this problem: In order to mix most quickly, shall the starchy material be:

1. Put into all of the cold liquid? or
2. Shall twice as much cold liquid as starchy material be put onto the starch to prevent lumping?

What would be the effect of putting a smaller quantity of water onto the flour and mixing? Try it.

b. To find out the difference in effect of putting hot and cold water on the starchy material.

1. Use same quantity of flour as in *a,* adding twice as much hot water as flour in place of cold water. Is it smooth? Which is more desirable, *a 2* or *b 1*?
2. Use the more desirable method, then put the mixed flour into the rest of the liquid which has been heated.

Is there any advantage in heating part of the liquid this way? Explain.

c. To find out the effect of mixing the flour with sugar and fat.

1. Mix thoroughly equal quantities of flour and sugar and put into hot liquid.
2. Repeat *1*, using fat in place of sugar.

Conclusions. 1. From the description of starch grain's behavior in hot and cold water, and from these experiments explain the formation of a lump.

2. Give methods of mixing which will prevent it.

Cocoa and Chocolate. Cocoa and chocolate are unlike tea and coffee in containing nutrients which the body can use. Like tea and coffee, however, they contain a stimulant. They are made from the beans of the cacao tree, a native of the American tropics. The beans, about the size of almonds, are freed from the long pod and allowed to ferment in ovens or in holes in the ground for about two days. The flavor of the product depends largely upon the care with which this fermentation is carried on. The beans are then dried in the sun and changed from white to their characteristic red. They are next roasted and the shells removed. From these shells is made a cheap preparation having a cocoa flavor. The roasted kernels are next crushed, making cocoa nibs, and these are ground to a paste. This is mixed with sugar, spices and flavoring or not, as sweet or plain chocolate is desired. It is then run into a mold and comes out as we see it in cakes

of chocolate. If cocoa is to be made, some of the fat is first pressed out.

The composition of cocoa is as follows:

	Theobromine	*Fat*	*Starch*	*Cellulose*	*Ash*
Cocoa nibs	1.66%	44.74%	26.45%	4.30%	3.16%
Cocoa shell	1.78%	2.54%	....	17.04%	6.63%

Tannin is found in the raw bean but is rapidly changed to form cocoa red to which the color is due.

Theobromine is a stimulant of the same nature as caffein and theine, but is milder in its effects. Since it is a stimulant, cocoa and chocolate as beverages and as flavorings in puddings and candy, should not generally be given to young children, particularly if they are easily excited or stimulated.

Experiment 46. To prepare cocoa and chocolate.

Directions.—Cocoa. Choose from the following proportions, and make 1 cup of cocoa:

1 to 2 t cocoa (depending upon the brand of cocoa and the individual taste)

Speck of salt   1½ to 3 t sugar   1 c liquid

NOTE. The liquid may be equal quantities of milk and water or ¾ milk and ¼ water.

In order to destroy the raw, starchy taste of cocoa, and not boil the milk, how should this be cooked?

Considering the composition of cocoa, what precaution will you take to prevent lumping?

Chocolate. Let some members of the class make choco-

late, others cocoa, and compare the two as to flavor and smoothness.

3/8 sq. chocolate	1 c liquid (half milk and half water)
1 T sugar	
speck of salt	

In order to mix melted chocolate and milk without producing specks, add warm milk, a little at a time, to the melted chocolate. Or the chocolate may be put into the cold milk in a lump. When it is taken from the fire, use a Dover beater in it and all specks will disappear.

It is often desirable to use cornstarch instead of flour for thickening, or a brown sauce using browned flour, may be required.

The following experiment will show the amounts of each which will give a certain thickness.

Experiment 47. To compare the thickening power of browned flour, white flour, and cornstarch.

Directions. In each case use 1 T of the thickening material and 1/2 c water. Bring to boiling point and compare the thickening power of the three substances. To do this, add to the pastes made with flour and with cornstarch, a measured quantity of water, until they have the same consistency as that from the browned flour. Record the amounts of water.

a. Test a little of the browned flour with iodine. What is present?

Conclusions. 1. How much of browned flour or of cornstarch would be used to 1 c water to give the same consistency obtained with white flour?

2. How does the composition of browned flour affect its thickening power?

There are four general classes of white sauces:

Uses	Liquid	Flour	Fat	Seasoning
1. Thin—Cream soup, toast..	1 c	1 T	1 T	
2. Medium—Creamed vegetables and meats, gravies	1 c	2 T	1 T	
3. Thick—Croquettes	1 c	4 T	0	
4. Very Thick—Soufflés......	1 c	6 T	0	

Methods of putting fat into white sauce.

a. Melt fat over a very low fire, mix in flour, then liquid.

b. Mix flour and fat together, add to hot liquid. Boil.

c. Mix as in *Exp. 45, b 2,* adding fat when the white sauce is thickened.

Note difference in appearance of fat in *a, b,* and *c.* Is there any difference in taste?

White sauces often have a pasty taste due to too little cooking of the starch. This may be overcome by drying the flour in the saucepan before mixing any of the wet materials. The flour should not be browned, but simply heated until a little yellow.

Experiment 48. To prepare cornstarch pudding flavored with chocolate.

Cornstarch pudding is often objected to because it tastes raw. The following work will show how this result may be avoided.

Directions. A proportion of 1 T of cornstarch to 1 c milk makes a pudding which is a trifle less stiff when it is cold than jelly. If greater stiffness is desired, use 1½ to 2 T per cup. Use ⅜ sq. of chocolate and 2 T sugar per cup of milk. What is the easiest way of mixing the starch to prevent lumps? The chocolate may be put in as a lump, and

REFERENCE (for teacher). "Digestibility of Starch of Different Sorts as Affected by Cooking," Experiment Station, Bulletin 202.

the Dover egg beater used, if necessary, as in previous experiment. It has been found that 30 to 40 minutes of cooking, either in a double boiler or in the fireless cooker, does away with the raw flavor, although it does not make the starch more digestible.

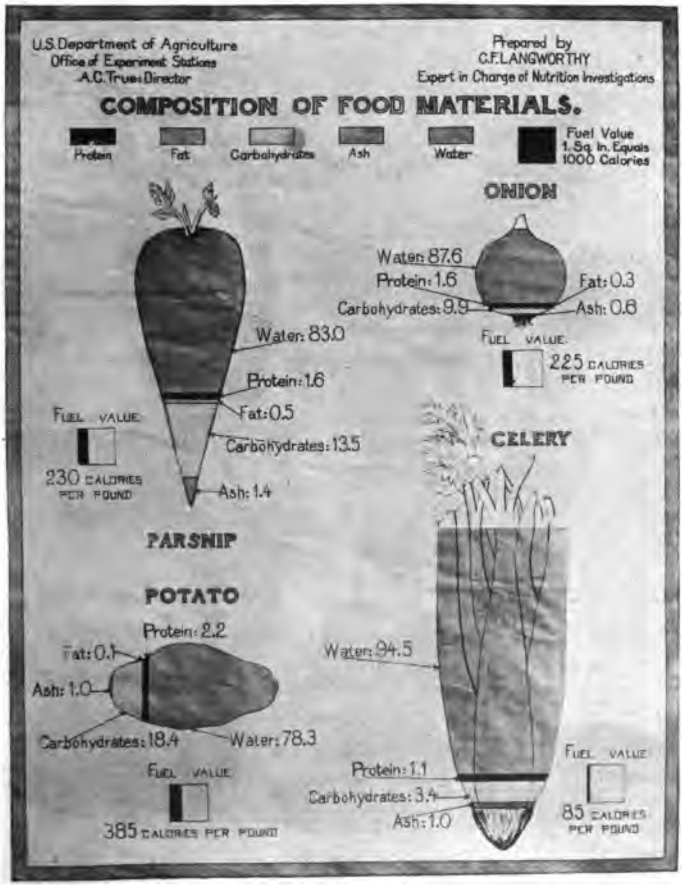


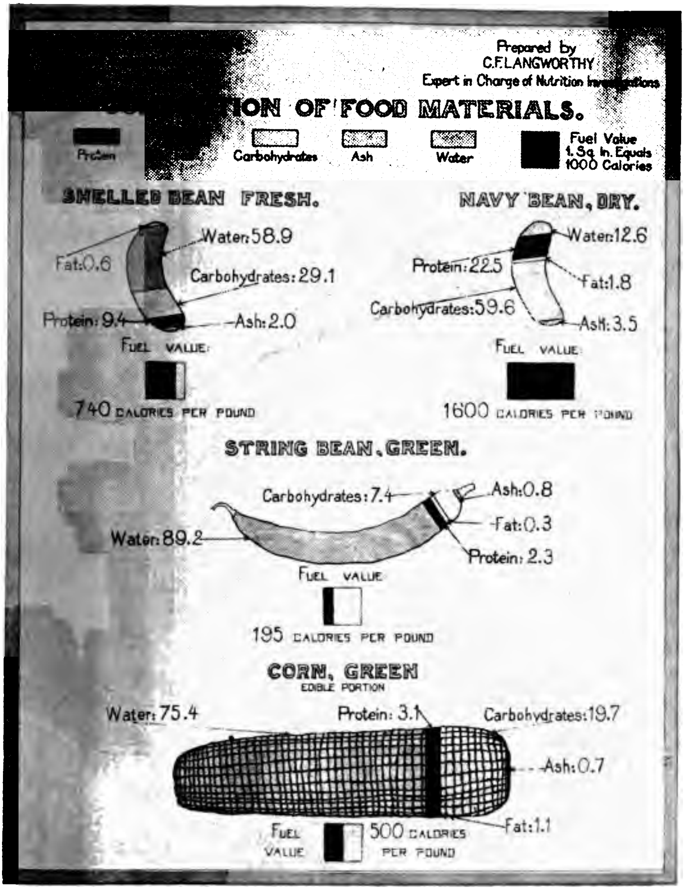
Plate 6.

CHAPTER XI

VEGETABLES

From a chart showing by lines the composition of vegetables, classify them. Notice the long line of water in all cases; notice also the difference in the length of the carbohydrate lines. Let all those which have carbohydrate lines as long or longer than that of peas, belong to one class, starchy; the other to a class which we may call watery. These differences in amount of starch determine the thickness of sauces used for creamed vegetables and for creamed soups; they also determine what to use in arranging a meal; for instance, one should not use two starchy vegetables such as potatoes, both Irish and sweet, for one meal, nor should either of these be served with rice or macaroni. Arrange vegetables in plates 6 and 7 in the order of the amount of the different nutrients present.

Vegetables are always watery foods. They contain kinds of ash which are very essential to the body, and which are found largely in fruits and vegetables. If we use the ordinary method of cooking in indefinite amounts of water, part of the ash, sugar, protein and starch will be poured off with the water, thus making many vegetables almost without nourishment. Recall the appearance of the water in which vegetables are cooked. This need



Prepared by
C.F. LANGWORTHY
Expert in Charge of Nutrition Investigations
...ION OF FOOD MATERIALS.
Protein
Carbohydrates
Ash
Water
Fuel Value 1 Sq. In. Equals 1000 Calories
SHELLED BEAN FRESH.
Water: 58.9
Fat: 0.6
Carbohydrates: 29.1
Protein: 9.4
Ash: 2.0
FUEL VALUE
740 CALORIES PER POUND
NAVY BEAN, DRY.
Water: 12.6
Protein: 22.5
Fat: 1.8
Carbohydrates: 59.6
Ash: 3.5
FUEL VALUE
1600 CALORIES PER POUND
STRING BEAN, GREEN.
Carbohydrates: 7.4
Ash: 0.8
Fat: 0.3
Water: 89.2
Protein: 2.3
FUEL VALUE
195 CALORIES PER POUND
CORN, GREEN
EDIBLE PORTION
Water: 75.4
Protein: 3.1
Carbohydrates: 19.7
Ash: 0.7
Fat: 1.1
FUEL VALUE
500 CALORIES PER POUND

Plate 7.

not be considered in fruits because we never pour off the water. The amount of nutrients lost from the vegetables would depend upon the amount of water used and the size of the pieces of vegetables. If the water in which the vegetables are cooked is used, as, for instance, in soup, or as part of the liquid in white sauce, then this practice is not bad.

The following table shows the losses which occur in cooking vegetables in different ways. The percentage of loss is from the fresh edible portion.

	Solids		*Ash*	
Spinach, boiled	31.59%	lost	51.65%	lost
" steamed	0.18%	"	9.34%	"
Difference	31.41%		42.31%	
Cabbage, boiled	32.86%	"	42.62%	"
" steamed	2.54%	"	11.47%	"
Difference	30.32%		31.15%	
Carrots, cut up and boiled	10.05%	"	11.48%	"
" boiled whole	6.28%	"	7.38%	"
Difference	3.77%		4.10%	

Carrots, steamed, 6% sugar lost.
" boiled whole, 17% sugar lost.
" boiled cut up, 26% sugar lost.

From *Home Economics Journal*, December, 1912, "Losses in Cooking Vegetables," Josephine T. Berry.

Conclusions. From this table what can be said as to:

1. Better method of cooking?
2. Effect of size of pieces?

Question. How would baking rank as a method of cooking?

As starch occurs in plants it is found among other nutrients. Since starch and fat perform the same work as a food for the body we are not so much interested in testing for fat as we are for protein, which plays a part which nothing else can do. Every living cell must contain some protein, but amounts differ greatly.

Millon's Test for Protein. Add a few drops of Millon's reagent to the solution to be tested. Heat. A pink color indicates the presence of protein. Millon's color test, by the depth of the color, shows the quantity only in a very general way.

Experiment 49. To test vegetables for starch, sugar and protein.

Directions. Test vegetables for starch, sugar, and protein and record results in a table as follows:

Name of Vegetable	*Sugar*	*Starch*	*Protein*
....	+ or −	+ or −	+ or −

PREPARATION OF VEGETABLES FOR COOKING

This varies somewhat with the type of vegetable. All vegetables used need thorough washing. *Head vegetables,*

NOTE. Millon's reagent is mercury dissolved in an equal weight of strong nitric acid, then diluted with twice the volume of water.

such as cauliflower, cabbage, and brussels sprouts, should be placed, head down, in a pan of cold water which has in it salt and vinegar in the proportion of 1 T salt and 1 T vinegar to each quart of water. This is for the purpose of drawing out any small insects which may be hidden in the vegetable. *Green vegetables,* such as string beans, celery, cabbage, asparagus, etc., and roots and tubers, such as parsnips and potatoes, should be firm and crisp before being cooked. If this is not the case, they should be soaked in very cold water until they become so. Vegetables with thick skins are pared before cooking by steam or boiling, while those with very tender skins, such as young carrots, should be scraped, thus losing as little material as possible.

Time of Cooking. This depends upon the age of the vegetable and upon the method of cooking employed. In boiling vegetables, the time varies anywhere from 15 minutes to several hours. For example, very young cabbage will cook in 15 minutes, while old beets and carrots will often take two hours.

Strong Flavored Vegetables. When vegetables have been kept until late in the winter, the flavor becomes very strong. In these cases it is sometimes wise to change the water during cooking, thus losing some of the nutrients but greatly improving the flavor.

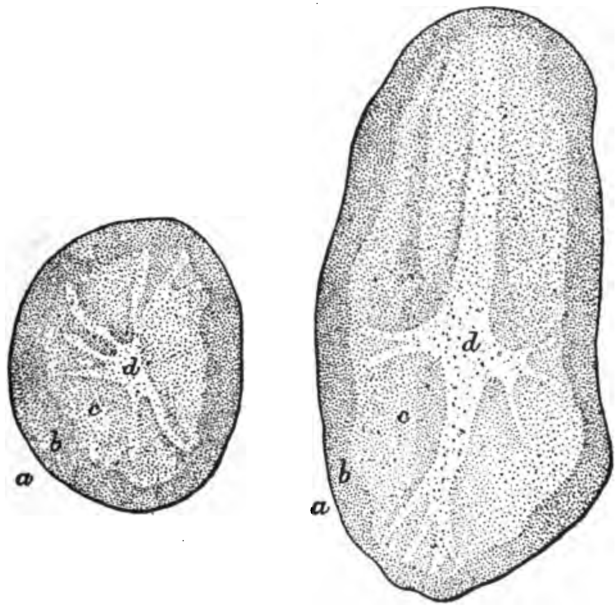
Covering of Vegetables. Vegetables keep their color better when cooked uncovered.

Potato as a Type of Starchy Vegetable. Potatoes are sometimes soggy in spite of the utmost care in preparation. This is due to their being watery, which may be told in this way: Cut across a potato. Inside of the skin three areas will be noted, decreasing in opaqueness as they approach the middle. See Fig. 1. The more opaque these areas are the better the potato is. Scabby potatoes should be avoided, if possible, because of waste in paring.

The framework of plants may be seen by scraping a potato.

Experiment 50. To separate the cellulose in potato from the other substanoes.

Directions. Grate a piece of potato into a glass of water. Allow it to stand a few minutes. Note the two kinds of



From Farmers' Bulletin 295, U. S. Dept. of Agriculture.

Fig. 1.—Transverse and longitudinal sections of the potato: *a*, skin; *b*, cortical layer; *c*, outer medullary layer; *d*, inner medullary area

substances. A potato has a small percentage of cellulose compared to the other vegetables. This cellulose or fibre grows harder and tougher as it grows old. When it is young it is tender and needs little water to soften it, for example, in young celery, and can be easily digested, while old cellulose is really woody fibre and requires the addition

of a great deal of water to make it soft, and then it is not digested.

Experiment 51. To bake potatoes.

Water is necessary to cook starch and cellulose. If a potato is baked, from where does the required water come?

How would the amount of water which a potato contains affect its mealiness when baked?

How would the piercing or breaking of a potato at the end of the baking affect its mealiness? Explain.

Directions. Prepare potatoes on the half shell by cutting baked potato lengthwise, removing potato from the

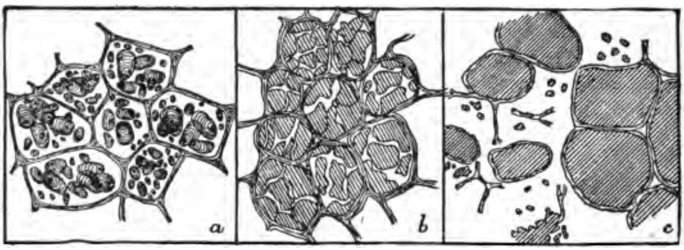


Fig. 2.—Changes of starch cells in cooking: *a*, cells of a raw potato with starch grains in natural condition; *b*, cells of a partially cooked potato; *c*, cells of a thoroughly boiled potato.

skins, mashing it and putting it back into the oven to brown. A piece of butter may be placed on top of each.

The characteristics of good mashed potatoes are:

1. Creaminess, which depends upon the amount of milk used.

2. Fluffiness, which may be obtained by:

a. Beating air into creamy potatoes.

b. By cooking potatoes, especially when in water, just until they are easily pierced by a fork, not until they fall to pieces, and then drying them by shaking the vessel containing them over the fire until their surfaces do not look wet.

Experiment 52. To compare steaming and boiling as methods of cooking sweet potatoes or carrots.

Directions. a. Cut vegetables into pieces of equal size. Put half of these into a steamer and half into water to boil.

Compare: 1. Length of time for cooking. 2. Flavor.

Serve according to methods in the next experiment.

Conclusion. Which is the better method? Why?

A steamer is on the market which consists of, first, a vessel for holding the water and on top of this three or four compartments fitting close to one another, one or more of which may be used at a time. Pipes stand in each of these compartments, connecting with one another to form a flue for steam. Into each compartment steam passes through an opening in the side of its pipe. Thus, different kinds of foods may be cooked in different compartments without danger of contamination. When gas is the fuel, using the steamer necessitates having the gas on full. The cooking of two vegetables requires from $\frac{1}{2}$ to $\frac{3}{4}$ as much gas as boiling these vegetables on different burners. The use of the third compartment for pudding, meat, or other vegetables would be clear gain so far as fuel is concerned.

Triangular vessels are also on the market which have a clamped lid. Three of these fit nicely over one burner. Vegetables cooked in these require very little water to keep them from burning and this is made into steam which cooks the food very quickly

with a small amount of gas, and need leave no water to be poured off.

Experiment 53. To show methods of serving vegetables which have been boiled or steamed.

Possibilities. *a.* Boiled, served with butter, salt, and pepper.

b. Scalloped.

1. Using white sauce.
2. Bread or cracker crumbs. Whether method 1 or 2 is used, depends upon the juiciness of the vegetable.
3. Grated cheese may be added to white sauce for cabbage, potato, cauliflower, or celery, and this may be browned in the oven.

c. Creamed.

d. Sautéd. (Cooked in a small amount of fat in frying pan.

e. Fritters.

f. Candied (for sweet potatoes), sprinkled with brown sugar, and browned in the syrup which this makes. Cooked in syrup either in oven or directly over fire.

Directions. Scallop tomatoes and either cabbage, corn, potatoes, cauliflower, or old celery.

Sauté parsnips or potatoes.

Cream carrots or onions.

Refer to *Exp. 47* for proportions for white sauce to be used with vegetables.

Experiment 54. To prepare cream of vegetable soups.

Cream soups are white sauces flavored with vegetable pulp or juice, or water in which the vegetable has cooked.

Directions. *a.* Use $\frac{1}{4}$ to $\frac{1}{2}$ c pulp to 1 c sauce. For soups flavored with juice or water in which the vegetable is cooked, use a maximum of $\frac{1}{3}$ c juice to 1 c sauce. The

amount of flour will depend upon the kind of vegetable used, the amount ranging from 1 t for potato soup to 1 T per cup for tomato soup.

Potato Soup

Directions. Dice potatoes. Boil them in just enough water to cover them. Drain the water and save it. This may be used as one-fourth of the liquid for the white sauce, which has a proportion of from 1 t to ½ T flour to 1 c of liquid. Add mashed potatoes in proportion of ¼ c potato to 1 c sauce. Season with salt and pepper and onion, celery-salt, and parsley, if desired.

The cooked starch of flour seems to have more binding power than the cooked starch of potato, therefore, it is necessary to use a little flour in spite of the fact that potatoes are rich in starch.

Write a recipe for a quart of:

1. Potato soup.
2. Pea soup.
3. Corn soup.
4. Celery soup.

Prepare *1* and either *2*, *3*, or *4*.

Weights and Measures in Vegetables. Selling vegetables and fruits by volume is exceedingly inexact. The larger the pieces the less readily are they packed; also, a low, broad measure will hold more pieces than a deep narrow one. Therefore the following table was compiled by the Woman's City Club of Chicago to promote honest measures.

Weights and Measures

1 pk spinach	= 3 lbs	1 qt string beans	= $\frac{3}{4}$ lb
1 pk apples	= $12\frac{1}{2}$ lbs	1 qt cranberries	= $1\frac{1}{16}$ lbs
1 pk onions	= 14 lbs	1 qt dried apples	= $\frac{3}{4}$ lb
1 pk potatoes		1 qt peaches	= $1\frac{1}{32}$ lbs
or beets	= 15 lbs	1 qt peas	= $1\frac{7}{8}$ lbs
1 pk carrots, turnips, parsnips, sweet potatoes			= $13\frac{3}{4}$ lbs

Dried Beans. Dried beans are a highly nutritious food when their composition is considered. They contain about 24% protein and 59% starch. However, they often give trouble in digestion. Snyder, of the University of Minnesota, has found that the amount of protein digested is increased when the skins of the beans are removed. Moreover, the digestive disturbance seems to be avoided also. He thinks that some of the germ is lost with the skin. The germ readily ferments and probably in this way is the cause of the feeling of flatulence.

Experiments have been conducted outside of the body which show that when the skins are removed, 42% of the protein of baked beans is soluble in the digestive juices, while from unskinned beans only 3.85% of the protein is soluble. It would seem wise then to remove the skins. To do this soak the beans in cold water to which has been added 1 t soda to 1 qt water. Soak these for a few hours, or over night, then bring them to the boiling point in the same water. Let them boil for a few minutes. This

water is then poured off and a large quantity of cold water is added. The beans may then be rubbed through the hands and the skins will come off easily. Being lighter than water the skins will float on top and so may be skimmed off from time to time. The beans must be cooked in the second water until they begin to soften, then the cooking may be finished in the oven.

In preparing beans for a very large number this may not be practicable. In this case soaking the beans for 8 or 10 hours in soda water, 1 t soda to 1 qt water, draining off the soda water and cooking them with fat meat in water for 12 to 15 hours in a fireless cooker and then adding the molasses and browning in an oven for about an hour makes very soft, palatable beans.

Experiment 55. To prepare baked beans.

Use the following proportions:

1 qt beans	½ to ¼ lb salt pork, cut in small pieces
1 T salt	
4 T molasses	

By adding a larger quantity of water, 1 pt to 1 c beans, and adding celery or onion, but omitting the molasses, of course, bean soup may be made.

REFERENCES. "Losses in the Cooking of Vegetables," by Josephine T. Berry, in *Home Economics Journal*, Vol. IV, No. 5, pp. 405-412.

"Food Value of Beans," Farmers' Bulletin 169, Experiment Station Work 22, p. 26.

"Cooking Beans and Other Vegetables," Farmers' Bulletin 342, Experiment Station Work 49, pp. 29-30.

"Green Vegetables and Their Uses in the Diet," by C. F. Langworthy, Year Book Separate, 582.

"Beans, Peas and Other Legumes as Food," Farmers' Bulletin 121.

"Preparation of Vegetables for the Table," Farmers' Bulletin 256.

"Course in the Use and Preparation of Vegetable Foods," Office of Experiment Stations Bulletin 245.

"Cooking Vegetables," Farmers' Bulletin 73. Experiment Station Work 4, pp. 23-27.

"Beans," Snyder, "Human Foods," p. 71.

"Potatoes and Other Root Crops as Food," Farmers' Bulletin 295.

CHAPTER XII

FATS

COMPOSITION—BURNING POINTS—FRYING

Composition of Fats. Although not all of the foods containing starch have been studied yet, fats must be understood at this point in order to fry some of the vegetables and cereals.

The fats used as food are made up chiefly of different proportions of olein, palmatin, and stearin which the chemists know as pure fats. What we have are combinations. Olein we see almost by itself in olive and Wesson oils. It has a low melting point (—5° C. or 23° F.) and a very high burning point. Palmatin is above olein in its melting point (45° C. or 113° F.) and below it in its burning point. Therefore, at ordinary temperature it is harder than olein. Stearin has a melting point of 53° C. or 127 2/5° F. and a burning point below that of olein and palmatin, consequently it is the least desirable for frying and the hardest fat at ordinary temperature. It enters largely into the composition of suet.

Cottolene and snowdrift are combinations of cotton seed oil, which is olein and beef stearin in different proportions, snow drift having more of the stearin than the cottolene. Crisco is a combination

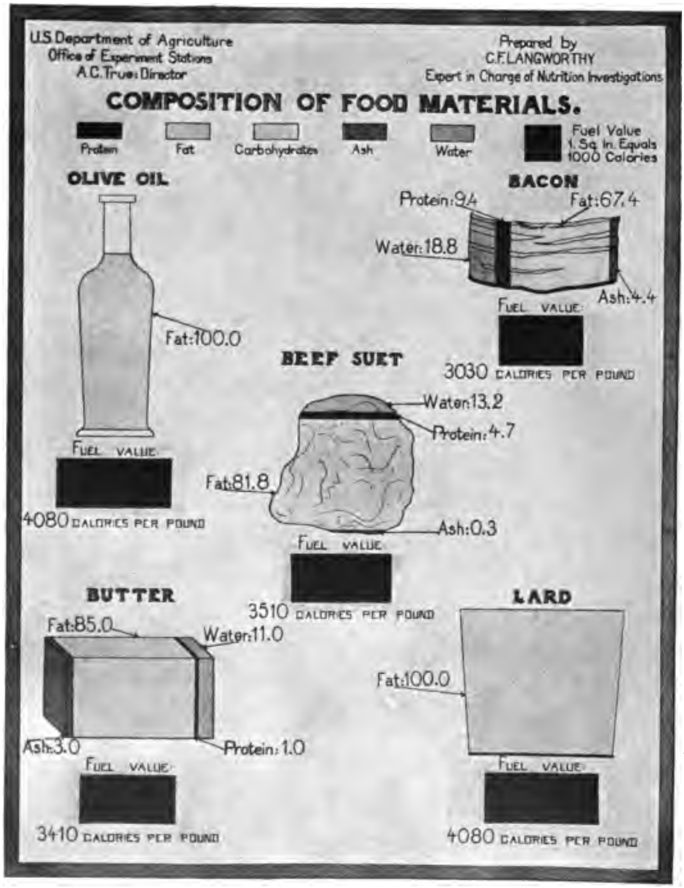


Plate 8.

Compare butter and lard as to the amount of fat in each.

of fats treated chemically, one of the results being that it has a higher burning point.

Effect of Heat on Fat. When the burning point is reached, the fat is decomposed into fatty acid and glycerin, and a substance called acrolein is formed from the glycerin. Some of this is volatilized and gives the irritating odor. This acrolein is thought to be irritating to the body. Therefore a fat which has a high burning point should be used for frying. Fat does not boil. The boiling appearance which it sometimes has is due to the presence of water. This lowers the temperature which may be obtained from the fat and therefore things which are fried in such fat become soaked with grease.

Experiment 56. To determine the burning points of different fats.

Directions. *a.* Heat butter, lard, crisco, and snowdrift or cottolene in test tubes. Heat gently and determine the temperature at which they melt, then heat longer, until the fat smokes and an odor rises. Note temperature of the burning point.

NOTE TO TEACHER. This experiment is better done as a class experiment.

Conclusion. What would be the best fat for frying? Why?

Experiment 57. To determine the relative cost of different fats.

Directions. Make a table showing the cost per pound and per cup of lard, crisco, snowdrift, cottolene, oleomargarine, and butter.

Conclusion. Which is the most economical fat to buy for frying, considering the burning point and the price?

Experiment 58. To determine tests for temperature to be used for frying.

Since by the appearance of fat it is impossible to tell its temperature this must be determined by some other sort of a test before frying foods. A fairly accurate method is by browning the crumb of bread. It is necessary to know, however, just what is meant by dark golden brown. Therefore, use a thermometer with which to determine the various temperatures accurately, then keep the fat within five degrees of the given constant temperature. Count as directed and use the color that results for your standard. Hereafter it should be possible to determine the temperature by browning the bread alone.

Use one of the following three temperatures in order to get the standard color of the bread crumb:

1. Put a few pieces of crumb into fat at 175° C. or 347° F. and count 60 seconds. Remove. Note the color. This temperature is used for articles which are not already cooked. These are fritters, doughnuts, breaded meat chops and timbal cases.
2. Put a few pieces of crumb into fat at 185° C. or 365° F., and count 40 seconds. Remove and note color. This temperature is used for articles already cooked. It would be used for meat, vegetable and fish croquettes, and for mush when cooked in deep fat.
3. Put a few pieces of crumb into fat at 195° C. or

383° F., and count 20 seconds. Remove and note color. This is used for Saratoga chips and French fried potatoes.

NOTE. French fried potatoes, uncooked material, would seem to belong to *group 1*, but the cooling of the fat due to the amount of water in the potatoes necessitates a higher temperature.

Prepare Saratoga chips or French fried potatoes.

Prepare potato croquettes. These are molded from mashed potatoes, dipped in flour, then in egg, and then in cracker crumbs before frying.

CHAPTER XIII

CEREALS

BREAKFAST FOODS—RICE—TAPIOCA—NUTS

The cereals are wheat, oats, corn, rice, barley, rye, and buckwheat. They each contain all of the different nutrients, but starch predominates. Wheat, oats,

Plate 9. — Shows the parts of a grain of wheat. The germ is sometimes known as the embryo, the endosperm as the kernel, and the five outer layers as the bran.

Published by courtesy of the Washburn-Crosby Company.

and rye are high in protein also. The others are much lower. Oats, wheat, and barley are high in ash. This makes them valuable in the diet of children.

The composition of breakfast foods made from cereals depends upon their process of manufacture and upon the constituents of the kernel which are used. Take the wheat kernel as a type. It is composed of five layers of bran, or cellulose, next to which lie a layer of protein and mineral material. The inside of the kernel is made up of a mixture of starch and protein plus a germ. The more it is refined the less cellulose there is allowed to remain. Cellulose needs to be softened by long cooking but it requires less water than starch does to cook it.

Cereals contain three kinds of starch. One of these is hard to dissolve and requires a long time for digestion. No cooking short of three or four hours makes them easier to digest. Unless the cellulose is softened and freed easily from the starch, much of the starch is excreted by the body. But with all the cooking, mastication is very important in making thoroughness of digestion and in preventing gas formation in the stomach and intestines.

Fireless Cookers. In order to save fuel and attention, and at the same time improve digestibility, and, to many people, the flavor of the breakfast food, a fireless cooker is used. The principle of a fireless cooker is this:

The material to be cooked in water is brought to the boiling point on the stove. Then it is put into a place surrounded by material which carries heat away from it very slowly, so slowly that the material

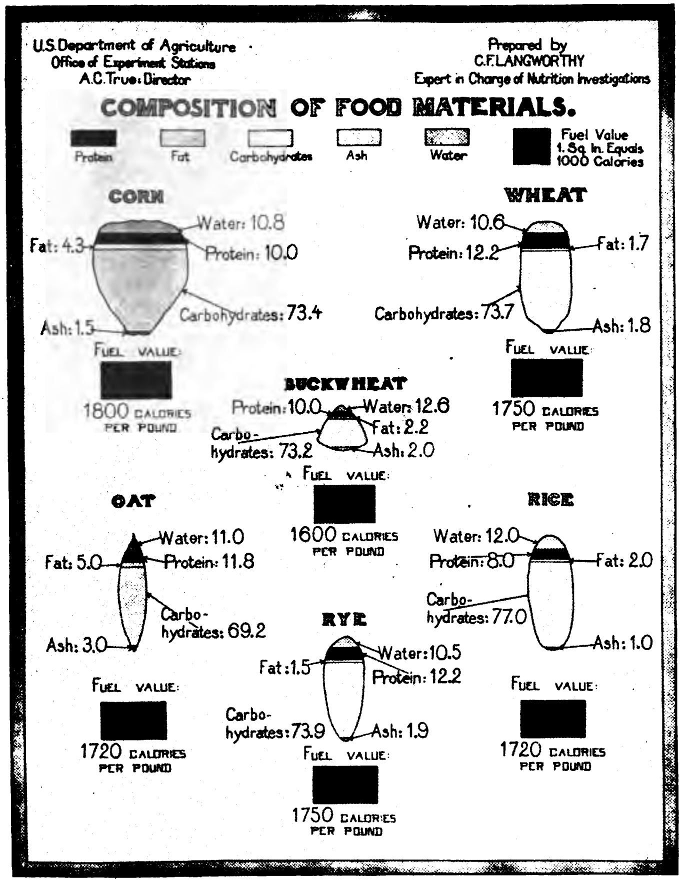

U.S. Department of Agriculture
Office of Experiment Stations
A.C. True: Director
Prepared by
C.F. LANGWORTHY
Expert in Charge of Nutrition Investigations
COMPOSITION OF FOOD MATERIALS.
Protein
Fat
Carbohydrates
Ash
Water
Fuel Value
1. Sq. In. Equals
1000 Calories
CORN
Water: 10.8
Fat: 4.3
Protein: 10.0
Carbohydrates: 73.4
Ash: 1.5
FUEL VALUE:
1800 CALORIES PER POUND
WHEAT
Water: 10.6
Protein: 12.2
Fat: 1.7
Carbohydrates: 73.7
Ash: 1.8
FUEL VALUE:
1750 CALORIES PER POUND
BUCKWHEAT
Protein: 10.0
Water: 12.6
Fat: 2.2
Carbo-hydrates: 73.2
Ash: 2.0
FUEL VALUE:
1600 CALORIES PER POUND
OAT
Water: 11.0
Fat: 5.0
Protein: 11.8
Carbo-hydrates: 69.2
Ash: 3.0
FUEL VALUE:
1720 CALORIES PER POUND
RICE
Water: 12.0
Protein: 8.0
Fat: 2.0
Carbo-hydrates: 77.0
Ash: 1.0
FUEL VALUE:
1720 CALORIES PER POUND
RYE
Water: 10.5
Fat: 1.5
Protein: 12.2
Carbo-hydrates: 73.9
Ash: 1.9
FUEL VALUE:
1750 CALORIES PER POUND

Plate 10.

is cooked before the temperature is so low as to be useless.

Consider what kind of handles are used on different cooking or laundering implements to prevent burning of the hands. How are steam pipes or hot air pipes kept from losing their heat in a place where it is not wanted? How do the lumbermen protect their feet and bodies from severe cold in the winters? What kind of bedding is warmest? The substances referred to are called poor on non-conducting materials. How are country houses sometimes protected at the foundation and at the windows in the winter time? From these illustrations make a list of poor conducting materials and construct a fireless cooker from a lard bucket, the cheapest non-conducting material that is clean, and a packing box. Be sure that the packing forms a layer of from 3 to 5 inches on all sides of the vessel and is so firmly packed that it does not move when the vessel is put in and taken out. In order to prevent any danger of fire, cover this packing completely and firmly with asbestos paper. Fires have been caused by putting hot soapstones or irons into fireless cookers. There is no danger when these are not used and when the packing is covered with asbestos and kept clean. Test the efficiency of this box with breakfast foods cooked over night.

Compare the efficiency of this cheap one with those which may be bought for from $5.00 to $20.00.

If economy is to be considered in buying food the following table will be serviceable in showing the comparative costs:

	Price per pkg.	Weight of contents in lbs.	Price paid per lb.
Mother's Crushed Oats.....2 for	$0.25	1.83	$0.071
Rolled Oats	bulk		.031
Quaker Rolled Oats.............	.12	1.89	.063
Cream of Wheat................	.15	1.70	.088
Granose Biscuit	.125	.67	.186
Pettijohn's Breakfast Food.......	.13	1.85	.07
Pillsbury's Vitos	.13	2.04	.064
Ralston's Health Breakfast Food..	.13	1.81	.072
Wheatena	.25	2.34	.107
Wheatlet	.13	1.90	.068
Grape Nuts	.15	1.03	.146
Force	.15	.91	.165

From Bulletin 84, "Cereal Breakfast Foods," Maine Agricultural Experiment Station, Orono, Maine.

Experiment 59. To determine the difference in amount of water required by a coarse and a fine cereal and the time required to soften each.

NOTE TO INSTRUCTOR. Pupils should work in groups. An individual portion would lose so much greater proportion of water that the amount of water needed for the family portion could not be obtained.

a. Use 1 c of each material, 1 t salt, and the proportion of water indicated on the package.

Since all cereals contain starch, what is the easiest method of mixing them to avoid lumps? At what point should a double boiler be used? Cook the cereals for the length of time mentioned on the package. Note the volume of the cereal after cooking.

b. Also cook a cereal in the fireless cooker for 4 hours at least. Use proportions of water to cereal as follows:

1 c Rolled Oats	2½ c water
1 c Cream of Wheat or Farina..............	6 c water
1 c rice	3½–4 c water
1 c cornmeal	4½ c water
1 c hominy	4½ c water

Use 1 t salt to 1 c uncooked cereal except when the cereal is to be used as a vegetable; *e. g.*, rice, in which case use 1 T.

Compare cereals cooked by these different methods as to 1. Flavor. 2. Softness.

NOTE. 1. Cook enough of fine cereal to mold and slice for frying.

2. Fresh fruit, bananas, apples, stewed fruit; *e. g.*, prunes, peaches, apricots, raspberries, etc., served on breakfast food make it more appetizing.

Question. 1. If you want to allow ½ c mush for one person, how much dry material would you use for your family? Note number in your family.

2. Why is there a difference in the amount of water required for cooking coarse and fine breakfast foods?

Experiment 60. To determine the results of cooking rice in different ways as to (1) length of time required to cook, (2) texture of the kernel.

Directions. *a.* Boil rice in a large quantity of water (8 times as much water as rice). Save the water from this rice if much cooking is being done. It serves as thickening and can be used in vegetable soup to advantage.

b. Bring rice to a boil in 4 times its volume of water. Cook in fireless cooker. Note the volume of rice before and after cooking. Allowing ⅓ c cooked rice per person, how much would you cook for your family?

c. From the rice in *a* and *b,* prepare rice pilaf and rice sweetened with fruit juice or date paste.

RICE PILAF

4 c rice (cooked)	½ ss pepper
2 c tomato, or	2 t salt
1 c tomato	Small piece of onion
1 c meat stock	Bread crumbs

To these may be added bits of meat, green pepper, and celery or celery salt, if desired.

DATE PASTE

Directions. Wash and stone dates. Cook in ⅓ their volume of water, stirring and mashing. This may be sweetened a little if desirable. Make a mound of this in the center of the rice when it is served. This may be used also on breakfast foods.

Tapioca. Tapioca is a starch found in the roots of the South American Cassava. Like all starches it is almost flavorless. It is about seven-eighths starch and one-eighth water. It is found on the market in two sizes, pearl and minute. The former is less expensive and just as desirable if a fireless cooker, or a coal or wood stove is used. It should

REFERENCES. *Cereal Breakfast Foods,* Bulletin 84, Agricultural Experiment Station, Orono, Maine. *Cooking Cereal Foods,* Experiment Station Work No. 48, Farmers' Bulletin 316, pp. 17-19. *Cereal Breakfast Foods,* Farmers' Bulletin 249. *Food Value of Corn and Corn Products,* Farmers' Bulletin 298. *Rice and Rice Cooking,* Cornell Reading Course Food Series, No. 8.

be cooked until there are no white spots to be seen. What kinds of materials might be added to make puddings out of tapioca? Dried apricots make a particularly good flavor with it. Water in the proportion of 8:1 should be used in cooking tapioca.

Nuts. There are those whose diet consists wholly of nuts and fruits. For others nuts are considered more as relishes after a hearty meal. A glance at the composition of nuts will show what concentrated foods they are.

	Water	*Prot.*	*Fat*	*Carbo.*	*Ash*	*Fuel Value per lb.*
Almond kernels......	4.8	21.	54.9	17.3	2.	3030 calories
Pecan kernels.......	2.9	10.3	70.8	14.3	1.7	3445 calories
Walnut kernels......	2.8	16.7	64.4	14.8	1.3	3305 calories
Chestnuts	31.	5.7	6.7	39.	1.5	1155 calories
Peanut butter.......	2.	29.3	46.6	17.1	5.	2830 calories
Shelled roasted peanuts	1.6	30.5	49.2	16.2	2.5	2955 calories
Shredded cocoanut...	3.5	6.3	57.3	31.6	1.3	3125 calories

From Maine Experiment Station Report.

Note in what nutrient peanuts stand first. They belong to the legume family.

Note also how chestnuts differ from the other nuts in composition.

Digestibility of Nuts. Nuts are very thoroughly digested. They need, of course, thorough mastication. If the body can take nuts without discomfort, and if they may be bought for 10 cents or less a pound, they may be used economically largely as a substitute for meat, if desired.

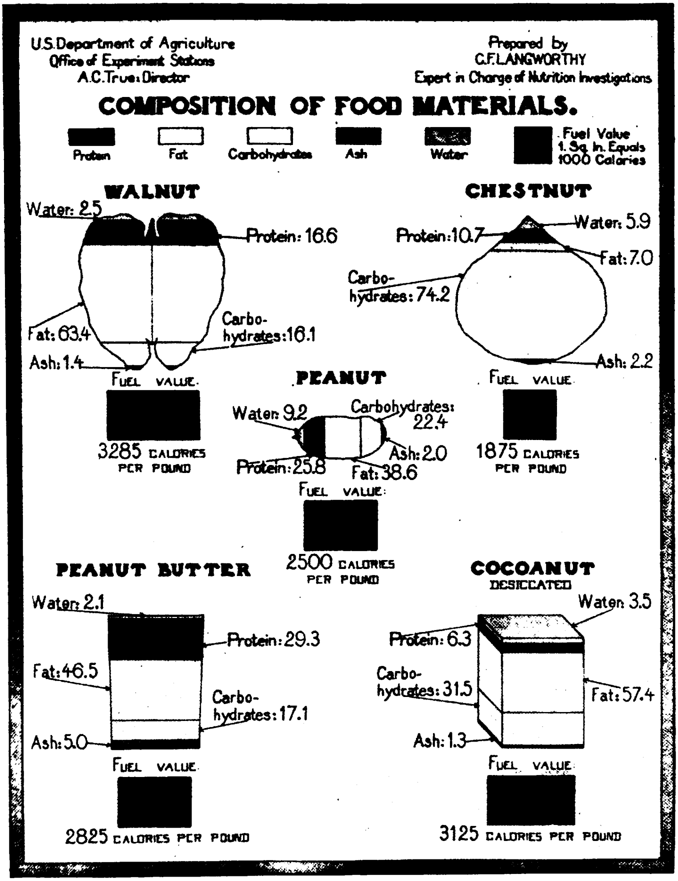


Plate 11.

Arrange the food materials in plate 11 in the order of the amount of (1) fat present, (2) carbohydrate present.

CHAPTER XIV

MILK

Milk as a Food. So far we have studied only foods from the plant kingdom. In these, with the exceptions of pure carbohydrates as sugar, starch, etc., all of the different kinds of nutrients have been found. The proportions in which they are present vary, and in no case is one of them suited to be the only food for man or animal. They all contain cellulose, which is a real food only when it is very young, but when older acts as an irritant to the digestive tract. This is not desirable for babies or sick people. Milk contains no cellulose, but it does contain all of the nutrients in just the right proportions to feed the young of the animal from which it is taken. Cow's milk must have water and sugar added to it to make it suitable for human babies. For older children and for adults milk forms a nourishing food, though, owing to changed requirements of the body, it should not be used as the only article of diet.

The milk which is used in this part of the world is largely cow's milk, but the use of goat's milk is strongly advocated by some and its use is increasing. In countries where there are no cows the milk of animals native to that country is used.

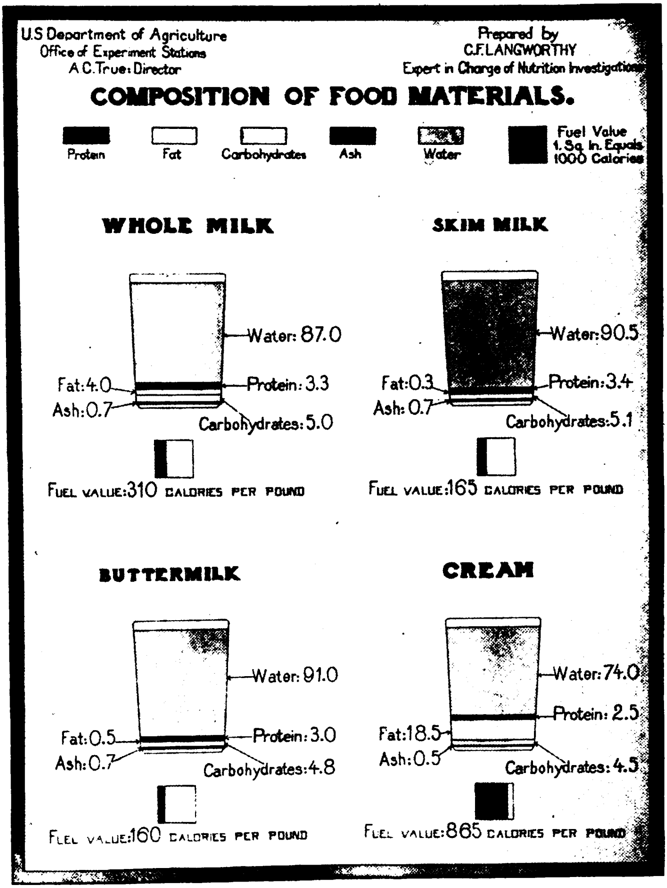

U.S Department of Agriculture
Office of Experiment Stations
A.C.True: Director
Prepared by
C.F.LANGWORTHY
Expert in Charge of Nutrition Investigations
COMPOSITION OF FOOD MATERIALS.
Protein
Fat
Carbohydrates
Ash
Water
Fuel Value 1. Sq. In. Equals 1000 Calories
WHOLE MILK
Water: 87.0
Fat: 4.0
Protein: 3.3
Ash: 0.7
Carbohydrates: 5.0
FUEL VALUE: 310 CALORIES PER POUND
SKIM MILK
Water: 90.5
Fat: 0.3
Protein: 3.4
Ash: 0.7
Carbohydrates: 5.1
FUEL VALUE: 165 CALORIES PER POUND
BUTTERMILK
Water: 91.0
Fat: 0.5
Protein: 3.0
Ash: 0.7
Carbohydrates: 4.8
FUEL VALUE: 160 CALORIES PER POUND
CREAM
Water: 74.0
Protein: 2.5
Fat: 18.5
Ash: 0.5
Carbohydrates: 4.5
FUEL VALUE: 865 CALORIES PER POUND

Plate 12.

Composition. The composition of milk from all animals is identical so far as kind of substances present is concerned. The difference lies in the amounts of these materials.

AVERAGE COMPOSITION OF COW'S MILK

Protein	*Fat*	*Sugar (lactose)*	*Ash*	*Water*
3.2%	3.9%	5.1%	.7%	87.1%

The proportion of nutrients present varies somewhat in different samples. The proportion of fat found in milk varies considerably with the kind of cow. For instance, the milk of Jerseys is very rich in butter fat, about 5%, while that of Holsteins is low, 3 to 4%, and that of Guernseys between the other two. To bring up the fat content of milk, dairymen frequently have in their herds a mixture of breeds of cows.

Skim Milk. Skim milk is whole milk from which the fat has been removed. It is a food not sufficiently appreciated. Practically the only difference between this and the whole milk is the loss of the fat. The milk may usually be bought for less than half the price of whole milk, thereby giving a very economical material for cooking purposes at least.

Buttermilk. True buttermilk is the residue left after the butter fat is removed from the cream in

butter manufacture. As most butter makers add salt in the process of butter making, buttermilk is usually salted. Ninety per cent, however, of the buttermilk consumed is not made in this way, but is artificially prepared from lactic acid bacteria which are put into the milk, then it is allowed to stand until the proper acidity has been reached. The milk used for this purpose is largely skimmed milk.

Of late years a great deal of interest has centered around the subject of buttermilk. It has been thought by some that the bacteria found in buttermilk restrained the action of putrefactive bacteria in the intestines and could destroy disease producing germs in the digestive tract. This has not yet been satisfactorily proved.

The great value ascribed to this milk as a food rests, at least partially, in the fact that it is easily digested. Compare composition of buttermilk with that of skim milk and whole milk. See plate 12.

Evaporated Milk. Evaporated or condensed milk is made by evaporating milk in a vacuum or by heating. Some condensed milks have cane sugar added. The average composition of these is:

Water	*Fat*	*Protein*	*Sugar (milk or cane)*	*Ash*
25.68%	10.99%	12.33%	48.66%	2.34%

If no cane sugar is added the percentage of sugar is 12 to 13%.

When used, these milks are diluted with water in order to have them approximate normal milk.

Within recent years the production of clean milk has been given much prominence. This has been due to the fact that many epidemics of diseases have had their source traced to milk. The infection of the milk by disease-producing bacteria may be due to disease which the cow has or to diseases transmitted to milk through outside infection, such as from the stables and from those handling the milk.

Clean Milk. The chief diseases which are thought to be transmitted to human beings through milk are bovine and human tuberculosis, typhoid fever, diphtheria, and scarlet fever. There is still some doubt about the transmission of bovine tuberculosis, but evidence is growing in support of the theory that it may be transmitted.

In order to obtain safe milk it is necessary to have conditions concerned with the production of milk, its delivery to the consumer, and the care in the home, such as will prevent the access of many bacteria to the milk and the multiplication of those already present. It must be remembered that by no means all bacteria found in milk are harmful, but that, as the number of the harmless bacteria increases, so the number of disease-producing ones increases, therefore the attempt is made to keep the number, or the count as it is termed, as low as possible.

In order to produce clean milk the care must begin with the cow and its surroundings and continue through the handling of the milk until it is used.

PRODUCTION OF CLEAN MILK

The precautions to be observed in producing clean milk are covered by the following points:

I. Cows.
- *a.* Cows should be healthy.
  1. Tuberculin-tested.
- *b.* Cows should be kept clean.
  1. Cleaned every day.
  2. Hair clipped and kept short around the udder and flank.
  3. Filthy pastures avoided.
  4. Pastures fenced in.

II. Stables.
- *a.* Location.
  1. Should be on well-drained ground.
  2. Should be free from contaminating surroundings.
- *b.* Construction.
  1. Should be constructed so as to be easily cleaned.
  2. Floors should be made of some hard, smooth material which does not absorb liquids.
  3. Floor should contain no cracks.
- *c.* Lighting.
  1. There should be about 4 sq. ft. of glass per cow.
- *d.* Ventilation.
  1. There should be adjustable windows.
  2. The windows should be screened.
  3. There should be air space per cow equal to about 500 cu. ft.

e. Cleaning.
1. The floor should be flushed daily with a hose.
2. The manure should be removed each day and deposited in a closed receptacle.
3. The stables should be whitewashed twice a year.

III. Milking.

a. Cows should be kept standing after cleaning, until milked.

b. Milking should be done in a place as free from dust as possible.

c. Milk pails should be held between the knees in such a way that the milk will have to pass through as little air space as possible.

IV. Milkers.

a. They should be free from infectious diseases.

b. A washable suit should be worn over the clothes ordinarily used.

c. A cap covering the hair should be worn.

d. The hands should be thoroughly cleaned just before milking.

V. Utensils.

a. A covered instead of open pail should be used.

b. Pails and pans should be seamless as far as possible. Where there must be seams the soldering should be smooth.

c. Utensils should be washed thoroughly, using clean boiling water or steam where possible.

d. Cans should be inverted on clean surface when drying.

VI. Handling of Milk After Milking.

a. It should be quickly removed from the room in which milking is done.

b. It should be cooled. See cooling room, page 145.
1. This cooling should be done promptly.
2. It should be cooled to 45° F.

3. It should be kept as near this temperature as possible during transportation to consumer.

c. It should be bottled as soon as it comes from the cooler.

VII. Care of Milk in the Home.

a. Have dealer leave bottle in a cool place.

b. If bottled milk can not be secured, put out a clean covered jar to receive the milk instead of any open vessel.

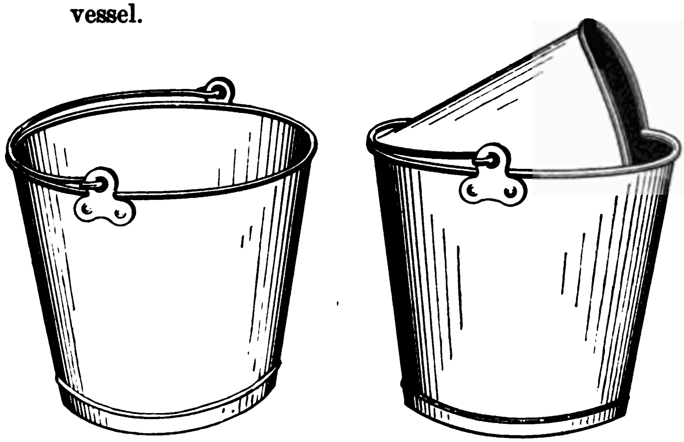


Plate 13.—Showing insanitary and sanitary types of milk pail.

c. Take milk into the house as quickly as possible.

d. Place on ice if possible. If not, stand it in cold running water or wrap in a wet cloth and place in the moving air so that evaporation of the moisture will take place rapidly.

e. Wash cap and bottle with clean hot water and wipe with a clean towel.

f. Remove the cap from bottle with a clean "lifter." Replace cap as quickly as possible and put milk back in a cool place.

If cap is damaged, invert a clean china cup over the top of the bottle.

g. Have absolutely clean all receptacles into which milk is poured.

Methods for Safeguarding the Milk Supplies. Various methods for safeguarding the milk supplies in cities have been adopted. Today there are, in most cities, three different kinds of milk on the market: inspected, certified, and pasteurized.

Courtesy of Dept. of Agriculture, Washington, D. C.

Plate 14.—Cooling Room.

Inspected. Inspected milk is that milk which comes from inspected dairies, tuberculin tested cows, and has a bacterial count of not more than 100,000 bacteria per cubic centimeter in summer and 50,000 to 60,000 in winter. If the cows, when tested with tuberculin, react showing the presence of tuberculosis, they must be cast out of the herd. There are

various score cards used for the inspection of the dairies and the amount that must be scored varies in different places. Inspected milk usually sells at about 10 cents a quart.

Certified Milk. Certified milk is produced under conditions which have been inspected and certified

Plate 15.—Bottling Milk and Placing It in Storage. Both Bottling and Capping Is Done by Machinery.

by a commission, the members of which belong to the American Medical Association. There are now about 75 such commissions in the United States. This commission usually demands that the milk contain not more than 10,000 bacteria per cubic centimeter, that there be a chemical analysis of milk

which shall show the milk to be of a certain standard, that sanitary conditions concerning the location of lands, conditions of buildings, cattle, etc., be maintained. In most instances, a weekly inspection of the dairy and a monthly medical examination of the employees is made, and a semi-annual tuberculin test of the cattle is demanded. In addition to these

Courtesy of the Dept. of Agriculture, Washington, D. C.
Plate 16.—Bottling Room.

conditions the milk is to be delivered to the consumer when it is not more than twenty-four hours old.

In recompense to the dairies for living up to these requirements a certificate is given which the dairies are entitled to use on their bottles.

Certified milk sells at about 15 cents a quart. At that price there is very little profit to the dairyman, for he has to pay the expenses of inspection as well as of fulfilling the requirements at the dairy.

Pasteurized Milk. Milk is pasteurized by being held at a temperature of 145° F. or 60° C. for 30 minutes. This temperature is used because it is the death temperature of the tubercle bacillus. The process makes the milk perfectly safe, providing it is not contaminated again before being used. Other disease-producing bacteria are also killed by this temperature.

Courtesy of the Dept. of Agriculture, Washington, D. C.

Plate 17.—Placing Bottles in Steam Sterilizer.

The pasteurization must take place in a closed vessel else a scum of caseid is formed such as is often noticed on boiled milk. This scum affords protection to the bacteria so that they are not all killed.

There has been much discussion about the value of pasteurization and many objections have been raised. Most of these objections have really applied to sterilized or boiled milk rather than to pasteurized

milk. The objection often made that pasteurization disguises dirty milk might be true if no inspection of dairies were required. In most places where pasteurization is enforced there is also required a certain scoring on the part of the dairy.

For instance, in Chicago the dairies must score 50 points. All other objections have been successfully met by people who understand the bacteriology of milk and who have studied the economic question of the milk supply.

From the results of this work there seems to be no question that pasteurized milk is safer than any other milk which can be obtained under present conditions.

Courtesy of the Dept. of Agriculture, Washington, D. C.

Plate 18.—Washing Milk Bottles on Revolving Brush.

Souring of Milk. As milk stands, the following changes take place: (1) It sours through the presence of the lactic acid bacteria. The acid continues to increase in amount until there is about 1% present. When this point is reached the bacteria cease to grow. Why? (2) In this acid medium molds begin to grow. They attack the casein, decom-

posing it and forming ammonia. (3) This changes the milk from an acid to an alkaline condition which is favorable for any bacterial spores which have been left.

During the first stage through which milk passes when it begins to sour it is used very acceptably in cooking, but in the last two stages it may be said to be spoiled.

Experiment 61. To determine the conditions under which milk sours most easily.

Directions. Take 3 sterilized test tubes. Into each place 10 cc. of fresh milk and 5 drops of blue litmus solution. Close with sterilized corks.

a. Place one at room temperature (70° F.).

b. Place one at refrigerator temperature (about 50° F.).

c. Place one near a stove or radiator. Take the temperature of the surrounding air.

Notice the order in which the fading of color takes place and the gradual appearance of pink, which indicates the presence of acid.

Conclusions. 1. What has temperature to do with the souring of milk?

2. Formulate a rule for the care of milk in the home in regard to temperature.

Experiment 62. To determine the percentage of cream in a quart of milk.

Directions. *a.* Let a quart of milk in a bottle stand for a few hours in a cool place (60° F.). Pour off the cream and measure. (Take it out with a cream spoon whose bowl is at right angles to its handle.)

b. Let a quart of milk stand in a pan in a cool place

(60° F.) for a few hours. Skim off the cream. Measure. In which case does the cream seem thicker?

c. Use the Babcock tester to determine accurately the amount of fat in the cream from *a* and *b*.

Conclusion. In which way, from pan- or bottle-setting, can the greater amount of cream be obtained?

Question. What is the state standard for the amount of fat in milk? in common cream? in whipping cream?

REFERENCE. State Food Laws obtained from your State Food Commissioner.

Instructions for Making Tests with Babcock Milk Tester—*Sampling.* Mix milk by pouring from one vessel to another two or three times. Fill pipette immediately after mixing by sucking the milk into it until it rises a little above the mark on the stem (17.6 cc.), then quickly place the forefinger over end of pipette. Slightly release the pressure and allow the milk to run down until it just reaches the mark. The finger should be dry so that a slight pressure will hold the milk. Do not close pointed end of pipette with the finger; it is awkward and unnecessary and a few trials will enable one to manipulate the sampling easily and quickly. Beginners may get practice in using the pipette by filling it with water to the mark.

The point of the pipette is now placed in the neck of the test bottle and milk allowed to run slowly down inside the neck. Care must be taken that none of the sample is lost. Hold bottle and pipette at an

angle so milk will run down one side of the neck and allow the air to escape.

Bottles should be marked with a wax pencil or otherwise so as to be easily identified.

Adding Acid. The acid cylinder, holding 17.5 cc., is filled to the mark with commercial concentrated sulphuric acid. Pour the acid carefully into the test bottle containing the milk. Hold bottle at an angle and turn slowly so that acid will wash all milk clear of the neck. *Never use the pipette for measuring acid.*

Mixing Milk and Acid. After adding the acid mix carefully, giving the test bottle a rotary motion. Use care that none of the liquid is shaken into the neck of the bottle. Shake until the mixture gets hot and is of a uniform brown color. Shake vigorously toward the finish. Do not place finger over top of bottle when shaking.

Whirling. When samples are all mixed, and while still hot, place in the tester, putting an equal number of bottles on each side so as to balance it. Whirl at rated speed (75 turns per minute for hand machines) for 5 minutes. This brings the fat to the surface of the liquid.

Adding Water. Hot water is now added by means of the pipette until the bottles are filled to a point near the scale on the neck. Then whirl again at full speed for one minute. Add hot water a second time to bring the lower end of fat column above the zero

mark on the scale and give a final whirling at full speed for one minute.

NOTE. It is possible to add sufficient water the first time to bring the fat into the scale, thus saving the third whirling, and this is often done, but results are better when the hot water is added in two portions.

Reading the Test. Each division on the scale represents two-tenths of one per cent and the space filled by the fat shows the per cent of fat in the sample tested. Measure the fat from the lower line of the fat column to the extreme top. The top is curved and when testing milk the reading should be made at the highest point. Subtract the reading at bottom from that at top. The difference is the per cent of fat. In testing cream in a cream test bottle, read to the bottom of curved line.

The temperature of the fat when read should be between 120 and 140 degrees F. The fat should be in liquid form and of a clear yellowish color. If fat is partly solidified, a correct reading cannot be obtained and the bottles should be set in hot water for a few minutes before reading.

Effect of Temperature upon Milk. Whether fruits, vegetables, or cereals are boiled or cooked below the boiling point makes no difference in their tenderness. In the cooking of milk great care must be given to the temperature. This is due to the protein that is present. In sweet milk the protein

is dissolved so that heat shows no effect on its texture. In sour milk the protein is thrown out of solution into either flakes or a large mass. The effect of different temperatures on protein in this condition may be easily seen. In foods from the plant kingdom the protein is so distributed among the other nutrients that the effect of heat is not noticed.

Experiment 63. To determine the proportion of curd in milk and the effect of different temperatures upon it.

Directions. *a.* Heat 2 c sour milk until the curd begins to separate slightly from the whey, or to 50° C. or 122° F. Drain, saving the water.

Measure the curd. What proportion of the milk used is it? Re-heat some of it, noting the effect of higher temperatures upon the curd.

Questions. 1. How does this percentage of curd compare with the percentage of protein given in tables of composition? Explain.

2. What is the cheapest kind of milk to buy to make cottage cheese?

3. To make a quart of cheese, how much milk should be bought?

4. If a thermometer cannot be used, how could the temperature be tested?

b. Using the best temperature, make cottage cheese. Write directions.

In order to make the temperature throughout more nearly the same, the pan of curd may be set in hot water; or this temperature may be obtained by pouring about an equal volume of boiling water into the curd. Chopped parsley, chopped olives, or pimentoes or paprika, or caraway seeds, may be used to flavor the cheese.

Since this cheese is made of skimmed milk, the flavor and consistency are improved by adding cream or butter when it is served.

CREAM OF TOMATO SOUP

Although in making cream of tomato soup sweet milk is used, yet the acid in the tomatoes is likely to make sour milk out of it before the soup is ready to serve. This does not decrease the food value of the soup, but spoils the appearance and is likely to bring up the problem of preventing the toughening of the flakes of curd with a boiling temperature.

Experiment 64. To determine the method of making cream of tomato soup to prevent its curdling.

Directions. *a.* To ½ T milk which has been kept at refrigerator temperature since delivery add ½ T tomato juice. Heat to the boiling point. Does it curdle? Test tomato juice with litmus paper.

b. Repeat, using this kind of milk, with 1 ss salt in place of acid. Heat to the boiling point. Does it curdle?

c. Repeat, using both salt and tomato juice.

d. Repeat *a, b,* and *c,* using milk which has stood at room temperature for some time.

NOTE. Students may be numbered in groups of three, alternate groups using milk kept in refrigerator, and that kept at room temperature for some time.

e. Neutralize the tomato juice with soda and add to milk kept at room temperature. Compare with *a, b,* and *c.*

NOTE. To neutralize means here to add enough soda to the acid tomato juice so that the color of neither blue nor red litmus paper will be changed by the juice.

f. Using the proportions which you found good for a cream soup from a watery vegetable, make cream of tomato soup in two ways.

1. Neutralize tomato juice with soda. Add to white sauce and heat.
2. Thicken the tomato juice. Add soda, then hot milk. (The pulp should be put through a sieve.)

Rennin. Milk becomes a solid food not only when it is soured, but when it is acted upon by rennin, as it is in the stomach. Rennin is an enzyme which is found in the gastric juice of animals. From the linings of the stomachs of calves an extract is made. This is dried at a low temperature and made into tablets called rennet or junket tablets. These are used to make milk have the consistency of a cornstarch pudding. Flavors added to it make it a very simple, pleasant, and inexpensive dessert. Since rennin is an enzyme which is sensitive to temperature and motion, and needs lime to help clot the milk, care must be taken that these three conditions are correct.

Experiment 65. To determine the conditions most favorable for the clotting of milk by rennin.

Directions. In each case let milk stand in the room for ½ hour without disturbing it after the tablet is added.

a. Add ⅛ rennet tablet, powdered, to ¼ c milk at boiling point.

b. Add ⅛ rennet tablet, powdered, to ¼ c milk at body temperature.

c. Add ⅛ rennet tablet, powdered, to ¼ c milk brought to boiling point and cooled to body temperature.

d. Add ⅛ rennet tablet, powdered, to ¼ c milk boiled for from 3 to 5 minutes and then cooled to body temperature.

In each case notice the texture of the clot that is formed.

Conclusion. Under what conditions does rennin form the best clot in milk?

Application. Prepare caramel junket.

Directions. Refer to "Variations in Flavor" under *Ice Creams.* Keep at room temperature until milk has become firm, then cool.

Question. What should be the order of adding freshly made caramel and junket tablet?

Conclusion. Write proportion and method of making caramel junket.

Milk which has been acted upon by rennin is commonly called *clotted.* Milk which has been acted upon by acid in the process of souring, so that the particles of protein are collected into a mass, is called *clabbered* milk.

Experiment 66. To determine the difference between clotted and clabbered milk.

a. Test each with blue litmus paper and record result.

b. Add soda to neutralize the clabbered milk. Can it be re-dissolved by stirring?

Stir clotted milk and compare it with fresh milk in appearance.

REFERENCES. "Milk Supply of Chicago and 26 Other Cities," Bulletin 126, University of Illinois. *The Case for Pasteurization* (Free. Send stamped, addressed envelope to Edwin O. Jordan, The University of Chicago.) "Milk and Its Products as Carriers of Tuberculosis Infection," Bureau of Animal Industry Circular 143. "Bacteriology of Commercially Pasteurized and Raw Market Milk," Bureau of Animal Ind. Bulletin 126. "Care of Milk in the Home," Farmers' Bulletin 413. "Care of Milk in the Home," Bulletin 21, Illinois State Food Commission, 1623 Manhattan Bldg., Chicago, Ill. "Chemical Changes Produced in Cow's Milk by Pasteurization," Bureau of Animal Industry Bulletin 166. "Medical Milk Commissions and Certified Milk," U. S. Dept. of Agri. Bulletin 1. "The Pasteurization of Milk," Bureau of Animal Industry Circular 184. "Directions for the Home Pasteurization of Milk," Bureau of Animal Industry Circular 197. "Milk and Its Relation to the Public Health," Hygienic Laboratory Bulletin 56, price $1.00. "The Pasteurization of the City's Milk Supplies," by Mina C. Denton in the *Journal of Home Economics,*

Vol. II, No. 3, pp. 279-289. "Restoring the Consistency of Pasteurized Cream," Farmers' Bulletin 69, Exp. Sta. Work III, pp. 24-26. "Bacteria in Milk," Farmers' Bulletin 348. "The Digestibility of Raw, Pasteurized and Cooked Milk," Farmers' Bulletin 149, Exp. Sta. Work 20, pp. 20-27. "The Milk Supply of Chicago and Washington," Bureau of Animal Industry Bulletin 138.

CHAPTER XV

MILK PRODUCTS

CHEESE—BUTTER

Manufacture of Cheese. Rennin is used in the manufacture of all cheeses but cottage cheese. Either whole or skimmed milk is clotted with junket tablets. It is then heated to about body temperature, cut up, salted, pressed for some hours so as to remove most of the water. It is then wrapped in a close-fitting cloth and allowed to ripen. Ripening is the developing of flavor by the action of enzymes, already in milk, on its curd, or by bacteria and molds, which may be put into the curd to produce an especial flavor. As the ripening goes on the taste becomes sharper.

So-called "full cream" cheeses are made from whole milk only, but real cream cheeses are softer and contain more water and fat.

THE COMPOSITION OF CHEESE COMPARED WITH OTHER PROTEIN FOODS

	Water	*Protein*	*Fat*	*Carbo-hydrate*	*Ash*	*Fuel Value per lb.*
Cheese	34.2%	25.2%	33.7	2.4	3.8	1950 calories
Eggs	73.7	13.4	10.5		1.	720 calories
Milk	87.	3.3	4.	5.	.7	310 calories
Beef	54.8	23.5	20.4		1.2	1300 calories

This shows how nutritious a food cheese is and how it may be substituted for meat and eggs for the

sake of variety and economy. A large number of dishes may be made in which cheese is used and which would therefore serve as the principal dish at a meal. These groups may suggest possibilities for using cheese:

1. Soufflé.
2. Cheese soups and vegetables cooked with cheese.
3. Cheese custards.
4. Cheese salads, sandwiches, and pastry.

Experiment 67. To determine the effect of temperature on cheese.

Directions. a. Place a small piece of cheese in a test tube of cold water. Place the tube in a pan of water and heat, noting temperature of water in test tube when:

1. Cheese melts.
2. Cheese begins to be stringy.

Application. When and how would you add cheese to (1) creamed macaroni, (2) baked macaroni, to avoid toughness?

b. Prepare these. Write directions for making these. Use tomato sauce for *1* or *2,* using tomato juice instead of milk. Cheese must be added to suit the taste.

c. Spread crackers with cheese and heat in the oven until the cheese is melted, but not tough.

Conclusions. 1. Best temperature for cooking cheese.

2. Effect of overheating.

The Digestibility of Cheese. After a large number of experiments it has been concluded that all kinds of cheese, when raw, are very thoroughly digested and that they take no more energy for digestion than an equal quantity of meat. In these

experiments no digestive disturbances were produced. The cheese remained in the stomach for some time, and for that reason seemed to take longer for digestion than other protein foods. It seems that properly cooked cheese is as digestible as raw, but overcooked cheese may be a source of trouble.

REFERENCES. "Cheese and Its Economical Uses in the Diet," Farmers' Bulletin 487. "Varieties of Cheese," Bureau of Animal Industry Bulletin 146, Farmers' Bulletin 487. "The Digestibility of Cheese," Bureau of Animal Industry Circular 166.

Butter. Butter is another product from milk. It is made by churning cream which has been skimmed or separated from milk. Churning means creating such motion that the particles of fat as they exist distributed through the milk are freed and collect in small masses. Churning may be done in a bowl with an egg beater or spoon, in an old-fashioned wooden or earthenware churn, or in a barrel churn run by a motor.

Either sweet or sour cream may be used. The bacteria found in clean milk produce in sour cream a delicate flavor which is one of the characteristics of good butter. Sweet cream butter lacks this flavor but is preferred by many. Some prefer unsalted butter, but in this country it is rather uncommon.

Experiment 68. To make butter from sour and from sweet cream.

Directions. a. Use ½ pt whipping cream. Have it at a temperature of 50° F. in warm weather, 60° F. in cold

weather. The fat exists in the form of an emulsion, that is, in tiny globules scattered through the milk. As the cream is churned the fat globules stick together more and more until masses of butter about the size of peas or beans are obtained. When they are of this size it is considered best to stop churning and wash these free from the buttermilk. To do this, drain off the buttermilk and add to the butter that amount of water of about the same temperature. Work the water through the butter and add salt, using 2 T to 1 lb. After the salt has been worked in for a little while, squeeze out the water until the butter assumes a waxy appearance. Too long working gives a salvy appearance, like lard, which is undesirable.

b. Repeat this process using slightly soured cream.

Conclusions. 1. What is the difference between sweet cream and sour cream butter in (*a*) flavor, (*b*) quantity, (*c*) time to churn?

2. Calculate the cost of butter from *a* and *b*.

3. Compare with the current cost of good creamery butter.

4. Compare the flavor with that of creamery butter. Keep for a few days in the refrigerator along with some creamery butter. Is there any difference in the rate of becoming strong? Explain.

5. To what is the difference in flavor between sweet cream and sour cream butter due?

6. What is the composition of buttermilk?

Renovated Butter. What is known as renovated butter has been found in our markets since the early '90s. It is made largely from country butter, or other butter which is produced in large quantities in the warm seasons and has become rancid. This

rancid butter is melted and the bad odors are taken out by different processes through the action of heat, washing, and skimming, leaving a fat almost free from taste or odor. To be made to resemble genuine butter again it is mixed with milk, buttermilk, or cream, and granulated by cooling. It is now in the form of churned cream again, ready to be made into butter. When first manufactured its keeping qualities were poor. It became rancid quickly. With later processes of manufacture this has been much improved and much of the butter which we buy as creamery butter, and think fairly good, is renovated butter. This is sometimes known as sterilized, or process, butter. The grade of this butter depends upon the grade of the stock from which it is made. Fraud lies in selling this renovated butter at the price of genuine, fresh butter. Tubs of what is called dairy butter are frequently renovated butter.

Manufacture of Oleomargarine. Oleomargarine is made from a mixture of animal fats. To this is added enough butter to flavor it. The fats from beef suet which have the lower melting points are separated from the harder fats in it, are mixed with different quantities of butter to give flavor, and churned. It is perfectly wholesome. The cost depends upon the amount of butter used in it. Since these two substitutes for butter are often sold as creamery butter it is convenient to know the following simple test for them:

Experiment 69. To determine a method of distinguishing butter, renovated butter, and oleomargarine.

The simplest test is the spoon test. Into a tablespoon put a small quantity of the article to be tested. Hold it over a low flame. Bring it to a brisk boil and stir the contents of the spoon thoroughly two or three times during the boiling. Oleomargarine and renovated butter boil noisily, sputtering like a mixture of grease and water. Oleomargarine produces no foam. Renovated butter usually produces a very small amount. Genuine butter boils with less noise and produces an abundance of foam.

Combination of these may be made, such as a mixture of renovated and genuine butter. This would be indicated by the noise and the foam. Similarly, oleomargarine might be combined with some renovated or genuine butter.

REFERENCES. "Pasteurization as a Factor in Making Butter from Cream, Skimmed on the Farm," Bulletin 138, Ill. Agri. Exp. Sta. "Butter Making on the Farm," Farmers' Bulletin 241, Exp. Sta. "Detection of Oleomargarine and Renovated Butter," Farmers' Bulletin 131.

CHAPTER XVI

EGGS

Composition. The egg contains all of the nutrients necessary to form the chick: protein, ash, water, a fuel material, fat, but no carbohydrate. The white and the yolk differ in composition as follows:

	Water	*Protein*	*Fat*	*Ash*	*Food Value per lb.*
White	86.2%	12.3	.2	.6	250 calories
Yolk	49.5	15.7	33.3	1.1	1705 calories
Whole Egg............	73.7	13.4	10.5	1	720 calories

See plate 19.

This shows a decided difference in water and fat. The tarnishing of silver is due to sulphur in the white rather than in the yolk, as is commonly supposed.

A comparison of the average composition of beef and cheese (given previously) with that of eggs shows them to be close to beef in composition and less concentrated than cheese. Since smaller quantities of cheese are likely to be eaten, these three food materials may be considered substitutes for one another.

The color of shells and yolks seems to indicate no difference in composition.

Cooking. Eggs contain protein in masses, so, like cheese, they are sensitive to heat. In order to find

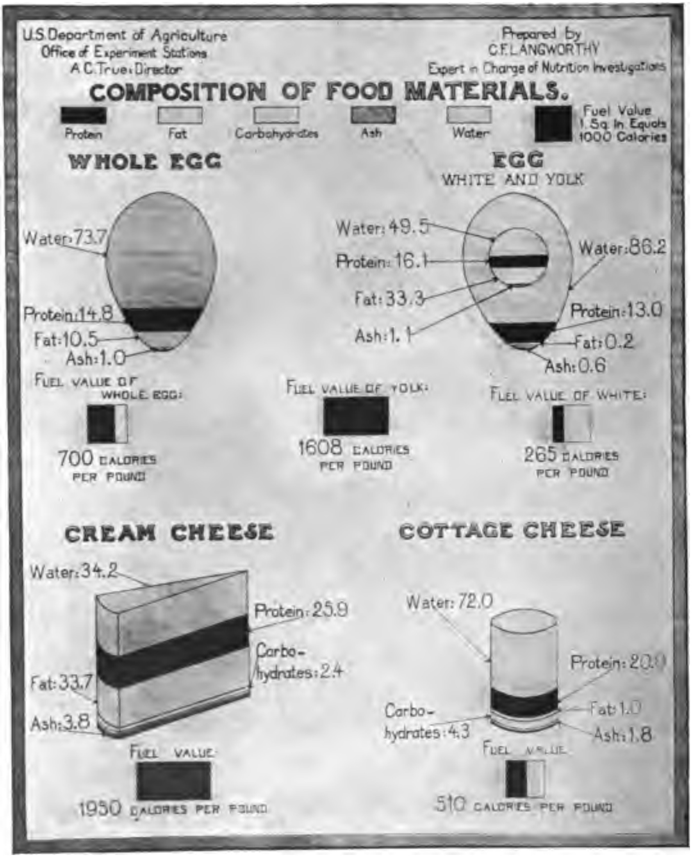

U.S. Department of Agriculture
Office of Experiment Stations
A. C. True, Director
Prepared by
C. F. LANGWORTHY
Expert in Charge of Nutrition Investigations
COMPOSITION OF FOOD MATERIALS.
Protein
Fat
Carbohydrates
Ash
Water
Fuel Value 1 Sq. In. Equals 1000 Calories
WHOLE EGG
Water: 73.7
Protein: 14.8
Fat: 10.5
Ash: 1.0
FUEL VALUE OF WHOLE EGG:
700 CALORIES PER POUND
EGG
WHITE AND YOLK
Water: 49.5
Protein: 16.1
Fat: 33.3
Ash: 1.1
Water: 86.2
Protein: 13.0
Fat: 0.2
Ash: 0.6
FUEL VALUE OF YOLK:
1608 CALORIES PER POUND
FUEL VALUE OF WHITE:
265 CALORIES PER POUND
CREAM CHEESE
Water: 34.2
Protein: 25.9
Carbo-hydrates: 2.4
Fat: 33.7
Ash: 3.8
FUEL VALUE
1950 CALORIES PER POUND
COTTAGE CHEESE
Water: 72.0
Protein: 20.9
Carbo-hydrates: 4.3
Fat: 1.0
Ash: 1.8
FUEL VALUE
510 CALORIES PER POUND

Plate 19.

out what the temperature of the water should be in which eggs are placed to poach that they may be prevented from spreading, perform the following experiment:

Experiment 70. To determine the solubility of white of egg in hot and in cold water.

Directions. a. Mix 1 t white of egg with a little cold water. Shake well and filter. Heat filtrate. Note change in appearance. Explain.

Conclusions. 1. As to solubility of egg in cold water and in hot water.

2. Apply to poaching eggs.

Experiment 71. In order to have a firm yet tender consistency in cooked eggs determine the effect of temperature upon the yolk and the white of egg.

Directions. a. Place in a test tube enough white of egg to cover the bulb of the thermometer. Immerse the tube in water and note temperature at which first coagulation appears. Continue heating and take out a little egg at the following temperatures, noting consistency:

1. 75° C. or 167° F.
2. 85° C. or 185° F.
3. 95° C. or 203° F.

b. Repeat, using yolk in place of white.

Conclusion. From these results determine the best temperature for cooking eggs.

NOTE. To cook eggs in water at a temperature below boiling, drop them in when the water is boiling. Cover them with a lid and turn the gas so low that there is no sign of movement in the water. Try this temperature with a thermometer. The water should cover the eggs. The temperature and number of eggs, the amount of water,

Application. Apply this experiment to:

1. Cooking eggs in the shell, hard and soft.
2. Poaching. Apply *Experiment 70.*
3. Scrambling. Use either yolks and whites or yolks alone. Add $1\frac{1}{2}$ ss salt for each egg and $\frac{1}{2}$ as much liquid as egg. Stir while cooking.

c. Sauté eggs (cook them in fat in a frying pan).

d. Prepare in the class two eggs, one cooked at the boiling point and one near 85° C. or 185° F., according to each of the four methods.

Experiment 72. To prepare foamy and French omelet.

Directions. Use for each egg 1 T liquid, milk or water, and $1\frac{1}{2}$ ss salt. For a foamy omelet add the liquid to the beaten yolk and then add these to the stiff whites of eggs, folding them in so as to retain a quantity of air. A French omelet differs in having the yolk and white beaten together. Each is put into a frying pan containing a small amount of hot fat. What temperature should be maintained?

Question. What is the purpose of beating the whites separately?

A foamy omelet is cooked until it is brown on the bottom. To cook the top, a lid may be kept on during the process of cooking, or it may be placed in an oven from which the heat has been turned off or, if it is a wood or coal stove, with a door open. A French omelet may be cooked in the same way, or it may be browned on the bottom, then pricked as it cooks, to allow the liquid on top to reach the hot pan.

the size of the pan, and the amount of heat lost in accidental draft, all take part in determining the temperature of the water and the time necessary for cooking to any certain consistency. By keeping these conditions practically the same, the time for cooking may be determined for each consistency. In general, 10 minutes is sufficient to cook an egg hard. Eggs cooked by this method may be called "soft or hard cooked" rather than "soft boiled" or "hard boiled."

Materials which may be added as flavor to omelets:

Bits of meat	Chopped parsley
Jelly	Nuts
Sugar	Oysters
Tomato sauce	

Size of Eggs. The great difference in the size of eggs makes it seem much better to buy eggs by weight than by count. On an average eight to nine eggs weigh one pound.

Preservation. The flavor of eggs may be injured by flavors of materials in which they are packed; *e.g.,* musty straw or bran. Far more commonly, bacteria, either originally in the eggs, or those which have entered through the pores of the shells, are responsible for lack of freshness. The same conditions of temperature and time control the rate of growth of these bacteria as in the case of milk. The normal egg shell has a natural mucilaginous coating over it, which, unless it is softened by washing, assists in preventing the entrance of bacteria. Eggs should, therefore, be kept in a cool place from the time they are laid until they are eaten. Tainted cold storage eggs get their taint not from being in cold storage, but from the careless treatment which they receive before this. The results of preserving eggs by different methods through a period of eight months showed the following results:

Brine,—salt absorbed by egg, not edible.
Wrapped in paper,—80% bad.

Rubbed with salt,—70% bad.

Packed in bran,—70% bad.

Covered with paraffin,—70% bad.

Partially sterilized by placing in boiling water for 12 to 15 seconds,—50% bad.

Varnished with vaseline,—all good.

In lime water,—all good.

In solution of water glass,—all good.

Of the last three, water glass is to be recommended. To use this: buy commercial water glass, but be sure that it is not very alkaline. Some on the market is, and this gives the eggs a bitter flavor. Water glass may be bought as a thick syrup or as a powder; if as a syrup, use one volume of it to ten volumes of water. Boil the water and cool it before mixing with the water glass. A clean vessel should be used in which to pack the eggs, and the eggs themselves should be clean though not washed. A tight lid should cover the vessel, which should be kept in a cool place, otherwise a deposit will form on the eggs which is difficult to wash off thoroughly enough to avoid a trace of bitterness. Four gallons of water glass solution will be sufficient to pack 50 dozen eggs.

It must not be expected that any preserved eggs will taste exactly like fresh ones. Water glass has been found to produce fewer failures in flavor than any other method and to keep the yolk in the proper position.

Digestion. The method of cooking eggs seems to affect the length of time required for digestion more than the amount digested. A series of results were obtained by observing the digestion of eggs in the stomach of a soldier. A wound had healed leaving an opening in the stomach, covered only by a flap of the lining, which could be easily pushed aside. In this way Dr. Beaumont, an army surgeon, observed the following results:

Hard boiled and fried eggs remained in the stomach 3½ hours.

Soft boiled eggs remained in the stomach 3 hours.

Raw eggs, not whipped, remained in the stomach 2 hours.

Raw eggs, whipped, remained in the stomach 1½ hours.

Later experiments show a slightly more rapid digestion of eggs cooked below the boiling point than of those boiled.

Experiment 73. To determine the best method of making an angel food cake.

Directions. *a.* Proportions:

1 c of egg whites (8—9)
¾ c bread flour
1 or 1¼ c sugar
¾ t cream of tartar
1 ss salt
½ t lemon and ½ t vanilla extract
Use ⅛ of above proportion

b. Mixing. Beat whites of eggs until foamy, then add cream of tartar and continue beating until stiff. Sift sugar and flour together two or three times and add them half at a time, through a sifter, to the whites of eggs, folding them in rather than stirring. Why?

To prevent sticking, the sides of the pan may be lightly oiled, or oiled paper may be placed in the bottom of the pan.

c. Temperature. Use a temperature of 210° C. or 410° F., or have an oven of such temperature that a large cake will bake in from 25 to 30 minutes. A one-egg cake requires a lower temperature (175° C. to 180° C. or 347° F. to 356° F.) in order to have a tender cake. If the lower temperature is used for the large cake, the time will be about 50 minutes.

We have been accustomed to think that angel food and sponge cake should be baked in a very moderate oven for an hour or an hour and a quarter. The temperature on the inside of the cake is the same whether it is baked in this oven or in the hotter oven for a shorter time; and the hotter oven makes the more tender cake, owing to the slighter evaporation of water. If the cake in the hotter oven is left in beyond the time noted, it, too, becomes tough. What is the difference in results using different quantities of sugar?

Experiment 74. To determine the best proportions, methods of mixing and temperatures for cooking soft custard.

NOTE. These experiments may be done in groups of four, each member of the group taking one part of the experiment and comparing results of other three members and of the group.

Directions. a. Use proportion of ½ egg yolk to 1 c milk and 2 T sugar.

b. Use proportion of 1 egg yolk to 1 c milk and 2 T sugar.

c. Use proportion of 1½ egg yolks to 1 c milk and 2 T sugar.

d. Use proportion of ½ egg yolk and 1 T flour to 1 c milk and 2 T sugar.

Make one-half cup of custard.

Considering the cooking temperature for starch and the cooking temperature for eggs, how would you mix *d?*

Note general directions below:

Methods of Mixing. 1. Mix sugar with yolk of egg and add to it the hot milk.

2. Add sugar to milk, heat, and add to yolk.

Use these methods of mixing alternately by groups. Let alternate persons use double boiler and saucepans directly over the fire.

The custard is done when it coats the spoon.

Questions. 1. If custard curdles, to what is this due?

2. If curdling is of short duration, it may be remedied by beating with a Dover egg beater. Explain this.

3. When should the flavoring be put in it if vanilla or lemon is used? These are solutions in alcohol.

Notice what happens if a drop of extract is put into a hot mixture. Explain.

3. What variations in flavoring could be made?

4. Which of the above proportions would be suitable for:

   a. Ice cream?

   b. Sauce for pudding?

   c. Floating island?

Conclusion. Write out a recipe for each one of these and the best method of mixing and cooking custard.

Application. What variations would you make in preparing chocolate or caramel custard?

NOTE. Some of the whites of the eggs may be beaten, sugar added, and dropped lightly on top of custard to make floating island.

Experiment 75. To prepare baked custard.

Directions. Use the same proportions as for soft custard, but change the amount of egg to 2 yolks or one large whole egg to a cup of milk. Combine materials as in soft custard, but thicken in the oven rather than directly over the fire.

1. When should the flavoring be added to this?

2. What flavoring might be used?

3. What precautions may be taken to prevent too high a temperature when it is cooked in the oven?

4. What would be the effect of over-cooking?

This custard is done when a knife run into it makes a clean cut.

Experiment 76. To prepare cheese custard, using as a basis—

a. White sauce—what proportions?

b. A custard.

PROPORTIONS

a. $\frac{1}{2}$ c milk	$\frac{1}{4}$ t salt
flour	$\frac{1}{4}$ t mustard
$\frac{1}{8}$-$\frac{1}{4}$ lb cheese	paprika

b. $\frac{1}{2}$ c milk
1 egg yolk or $\frac{1}{2}$ egg yolk and $\frac{3}{4}$ T flour
$\frac{1}{4}$ t mustard $\frac{1}{4}$ t salt paprika. Toast

Serve on bread toasted on one side, toasted side down.

Conclusion. Give method of combining materials in *a* and *b* so that the principles of cooking starch and protein have not been violated.

Question. What is the reason for a stringy, tough cheese custard?

NOTE. This is often called Welsh rarebit, although in the real rarebit milk is replaced by ale.

Experiment 77. To prepare soufflés.

Soufflés are inexpensive and attractive ways of using left-overs. They are either a spongy or a soft, firm basis with some flavoring material in it. This spongy basis may be either:

a. A thick white sauce, colored with the yolks and the beaten whites of the eggs used as leavening agent; or

b. A custard without the beaten whites; or

c. The whites of eggs by themselves.

For flavoring materials, cheese, bits of meat, vegetables, such as peas, corn, and potatoes, and fruits, such as apricots, prunes, dates, and peaches, may be used.

Directions. Let the student make either *1* or *2* of class *a* and an example of both class *b* and class *c*, using ¼ c of liquid and ½ egg white in class *c*.

Class a. PROPORTIONS

1.	6 T flour	2 yolks, chiefly to color
	1 c liquid	½–1 c finely divided materials for flavoring
	2–4 whites	

2. Prepare as *1*, but use 1 t baking powder in place of 1 egg white.

Questions. 1. What would be the difference in cost between *1* and *2* when eggs are 30 cents a dozen? Baking powder at 50 cents a pound costs about ½ cent per teaspoon.

Class b. Prepare a corn soufflé as an example of this class.

What proportion of egg to milk would you use to make a firm custard? Use as much corn as milk.

Use ½ egg white.

Class c. A fruit soufflé is a fruit whip. Use proportion of ⅔ c of fairly dry fruit pulp to whites of 2 eggs.

Cream or a fruit sauce may be served over this.

These soufflés of classes *a* and *c* are done when they rebound after being pressed lightly near the center of the top. The test for class *b* is the same as for what else?

Conclusion. Write out a method for mixing a cheese soufflé, a meat soufflé, and a fruit soufflé.

Experiment 78. To prepare sponge cake.

Sponge cake differs from angel food cake in that both the whites and the yolks of eggs are used. The flavoring is generally either lemon juice or lemon extract. The cake may be made light by the air in the egg whites, or by baking powder, which may be used as a substitute for part of the eggs, thus decreasing the cost. In the latter case, $\frac{3}{4}$ t baking powder and $1\frac{1}{2}$ T water are added for each egg left out; 1 t lemon extract may be used instead of 1 T lemon juice.

Numbering in groups of three, use the following proportions:

a. 6 eggs — $\frac{1}{4}$ t salt
1 c sugar — 1 T lemon juice
1 c bread flour

b. Change *a* to use 4 eggs.

c. Change *a* to use 2 eggs.

NOTE. The sugar may be increased to $1\frac{1}{4}$ c, if desired.

Mix as for foamy omelet, then add the sugar and flour as in angel food cake.

Bake these in ovens at the temperature which you used for angel food cake.

Conclusion. Give: 1. Difference in flavor.

2. Difference in lightness.

3. Best temperature and time for baking.

Problem. Find the cost of different cakes when eggs are 35 cents a dozen or 20 cents a dozen.

REFERENCES. "Eggs and Their Uses as Food," Farmers' Bulletin 128. "Composition and Digestibility of Potatoes and Eggs," Office of Experiment Station, Dept. of Agri., p. 20.

CHAPTER XVII

MEAT

STRUCTURE—EFFECT OF HEAT UPON MEAT—CUTS OF MEAT—METHODS OF PREPARING MEAT FOR SERVING

More money is spent for meat in many families than for any other article of food. This may be due to the buying of only expensive cuts, since knowledge of the nutriment in, and preparation of, poor cuts is often lacking, or because too much meat is eaten, no substitutes being provided for it by the use of cheese, eggs, beans, etc. How many dollars are spent for the unpalatable, tough meat served! The cook blames the butcher and the butcher lets the blame roll lightly from his shoulders, but he does not often know enough to tell the cook what is really the cause of tough meat. What does make it tough? We have seen what makes cheese and eggs tough. Comparing the composition of these with meat, it is found that the food nutrient, protein, is present in each. This might suggest that it is heat that makes meat tough.

It is true that too high a temperature used in cooking may be the cause of the toughness. On the other hand, it is sometimes found that meat is tough before cooking, and in spite of the proper temperature,

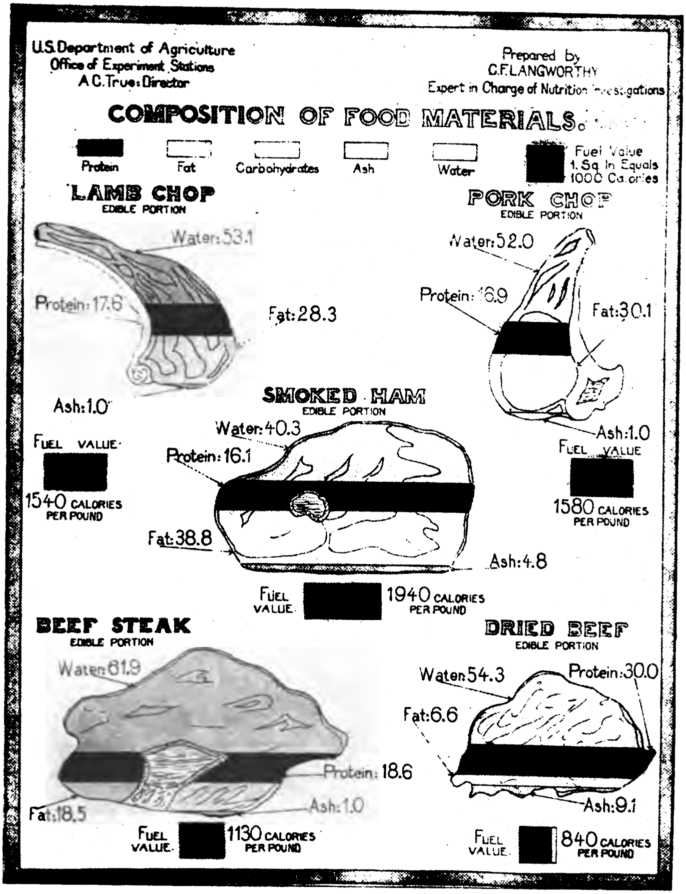

U.S. Department of Agriculture
Office of Experiment Stations
A. C. True: Director
Prepared by
C. F. LANGWORTHY
Expert in Charge of Nutrition Investigations
COMPOSITION OF FOOD MATERIALS.
Protein
Fat
Carbohydrates
Ash
Water
Fuel Value
1 Sq. In. Equals
1000 Calories
LAMB CHOP
EDIBLE PORTION
Water: 53.1
Protein: 17.6
Fat: 28.3
Ash: 1.0
FUEL VALUE
1540 CALORIES
PER POUND
PORK CHOP
EDIBLE PORTION
Water: 52.0
Fat: 30.1
Ash: 1.0
FUEL VALUE
1580 CALORIES
PER POUND
SMOKED HAM
EDIBLE PORTION
Water: 40.3
Protein: 16.1
Fat: 38.8
Ash: 4.8
FUEL VALUE
1940 CALORIES
PER POUND
BEEF STEAK
EDIBLE PORTION
Water: 61.9
Protein: 18.6
Fat: 18.5
Ash: 1.0
FUEL VALUE
1130 CALORIES
PER POUND
DRIED BEEF
EDIBLE PORTION
Water: 54.3
Protein: 30.0
Fat: 6.6
Ash: 9.1
FUEL VALUE
840 CALORIES
PER POUND

Plate 20.

that the muscles of the body that are unused are soft and flabby, while those which are much exercised, as, for instance, those in the arm, feel hard and tough. The same is true of the muscles of animals; that is, of meat. If a piece of meat is examined it will be found to be made up of small fibres which can be separated from one another. The difference between tough meat and tender meat seems to be that the fibres in tender meat can be separated more easily. These fibres, which may be seen in meat, are held together by connective tissue which becomes tougher as more strain is put upon it.

Experiment 79. To examine the structure of meat.

Directions. Take a piece of meat, separate these fibres and notice the shape and size and method of connecting the fibres. Examine the smallest divisions you can make under a microscope. Make drawings.

Experiment 80. To isolate the contents of the fibres.

Directions. Take a small piece of meat and, with a sharp knife scrape, not cut, the meat until you have a mass of (1) red scrapings, (2) white tough material left. Save this for *Exp. 81.*

A cross section of the smallest fibre would show it to be a tube, the outside of which is a connective tissue sheath called the sarcolemma. This sheath holds water in which are partially dissolved the protein, the coloring matter, and the extractives, which are the flavoring materials. These individual fibres are made up into bundles held together by threads of

connective tissue. The red scrapings are the contents of the fibres; the white ball is the connective tissue. Connective tissue is one of the substances which, when cooked in water, produce gelatin. The more a muscle is worked the thicker and tougher the connective tissue becomes. This, then, is the cause of toughness in meat before it is cooked.

Experiment 81. To determine the effect of heat upon the protein of the fibres and upon the connective tissue.

Directions. Divide the connective tissue and protein from *Exp. 80* each into three parts. Form protein into balls. Cook one part of the protein and one of the connective tissue in boiling water for ten minutes. Cook the other parts in water with no sign of movement in it for 15 to 20 minutes. Cook the third in a skillet, using no water.

a. Examine these, comparing the effects of temperature and of cooking in water and with dry heat.

b. Replace the ones which have been cooked in boiling water and boil 10 or 15 minutes longer. What is the effect of time on each?

Conclusions. 1. Which temperature is better when protein and connective tissue are cooked together as in meat?

2. What difference must be made in cooking tender and tough meat in water?

3. What would be the effect of cooking a piece of tough meat by dry heat as in oven roasting?

It will be readily seen that those parts of the animal engaged in movement will be the tough parts. These are the leg, the neck, and the muscles used in breathing, leaving as the most tender part the portion on the top of the back along the spine, back

of the neck and shoulders, and in front of the hind legs.

The flavor of beef, veal, birds, and game, at the time of slaughtering, is due to extractives which they contain. The older the animal the more of these are present. Food also affects the flavor.

Pork and mutton are deficient in extractives and owe their flavor to their fats. When meat is allowed to hang, that is, is kept in cold storage some time after killing, more flavors are developed by the action of enzymes and bacteria. This is a form of decomposition but perfectly harmless. Sometimes it proceeds for such a long time that the flavor is offensive to one who is unused to "high" meat.

When meats are cooked other flavors may be developed by browning in hot fat, or vegetable flavors may be given by diced vegetables or their salts; *e.g.*, onion, celery, or spices.

No relation exists between market prices and the proportion of flavoring substances contained in the various cuts. The following list gives the cuts of beef in the order of the amounts of extractives:

Round, 2%.
Clod, foreshank, 1.75%.
Chuck, hindshank, loin, neck, rump, 1.5%.
Rib, plate, flank, .75%.

The foregoing table shows clearly that the more expensive cuts of beef are not bought for their flavor, but for general appearance, convenience of cooking,

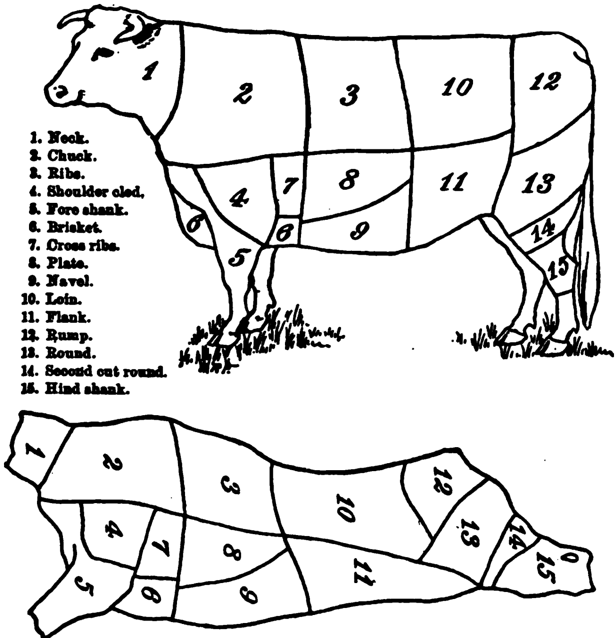


Fig. 3.—Diagrams of cuts of beef.

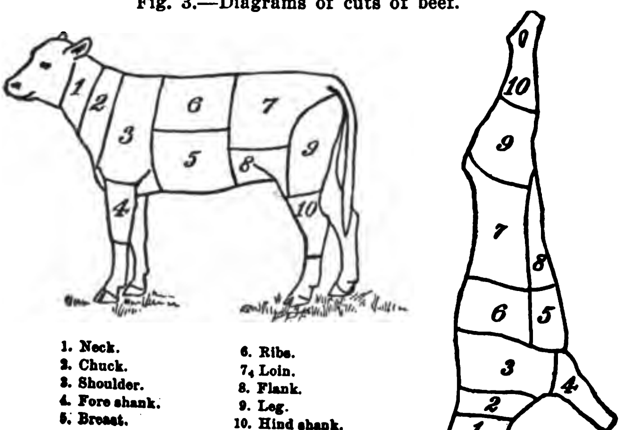


Fig. 4.—Diagrams of cuts of veal.

Indicate on the diagram the retail cuts of meat which come from each portion.

tenderness, and flavors developed by the method of cooking, as broiling and roasting. The table of composition, pages 186 and 187, shows that expensive cuts are not bought for their food value.

In addition to the selection of the proper cuts, the quality of the meat itself must be considered.

Good Beef. A stall fed ox is thought to furnish the best beef. The flesh appears firm, fine grained, light rather than dark red, and the lean well mottled with fat.

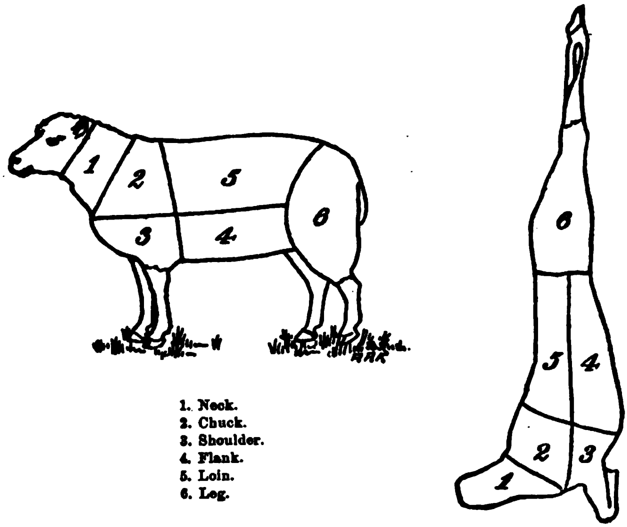
Good Veal. Calves under six to eight weeks old are not fit for good food. Their flesh is unwholesome and is called "green veal." Veal shows no fat through the lean, and little in other places.

Good Mutton and Lamb. Mutton comes from sheep at least three years old. It should be fine grained and of a pinkish red color. The fat is hard and almost white. In mutton the bone is white, in lamb it is pink.

Good Pork. The flesh of swine is almost colorless. It should be firm and fine grained. The fat should show no softness, though it is less hard than suet or tallow.

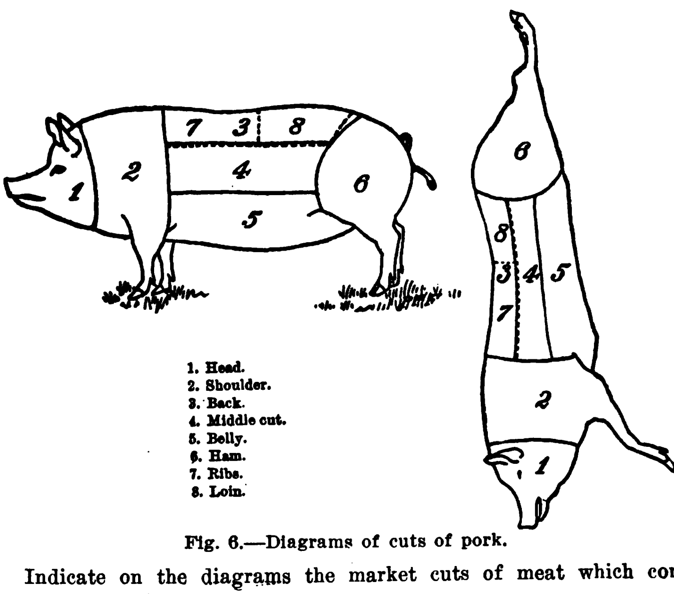
Relative Economy of the Various Retail Cuts.* From the proportions of lean, fat, and bone in the different cuts, their relative economy at retail market prices may be determined. The net cost of lean

* From Bulletin 158, University of Illinois.



1. Neck.
2. Chuck.
3. Shoulder.
4. Flank.
5. Loin.
6. Leg.

Fig. 5.—Diagrams of cuts of lamb and mutton.



1. Head.
2. Shoulder.
3. Back.
4. Middle cut.
5. Belly.
6. Ham.
7. Ribs.
8. Loin.

Fig. 6.—Diagrams of cuts of pork.

Indicate on the diagrams the market cuts of meat which come from each portion.

meat is an approximate index of the relative economy of steaks and roasts, since they are purchased and used primarily for the lean they contain; but in comparing boiling, stewing, and similar meats, the cost of gross meat, or fat and lean combined, should be more largely considered, because the fat is more completely utilized, as in the case of meat loaf, hash, Hamburger, and corned beef. Soup bones, being valued for flavoring matter as well as for the nutritive substance they contain, are more difficult to compare with other cuts in respect to relative economy. They vary materially, however, in proportions of edible meat and waste, and should therefore be studied in this connection.

The relative cost of lean meat in a given cut consists of the price per pound paid for the cut divided by the percentage of lean it contains; and, similarly, the cost per pound of gross meat is the market price of the cut divided by its total percentage of lean and fat meat. For example, in a steak costing 20 cents per pound and composed of 80 per cent lean, 10 per cent visible fat and 10 per cent bone, the net cost per pound of lean is 20 cents ÷ .80, or 25 cents, and the net cost per pound of total meat is 20 cents ÷ .90 (.80 + .10), or 22.2 cents.

Retail prices of beef cuts vary widely, depending upon market prices of live cattle and carcass beef; also upon the method of cutting and trimming used,

and upon local customs and conditions. Consequently, the relative economy of the different cuts varies accordingly and cannot, therefore, be expressed in fixed terms. The following table is based upon prices charged for the highest grade of beef cuts in first-class city meat markets. Although it fairly represents the relative net cost of the retail cuts under the conditions stated, the table is designed primarily to illustrate the method by which the relative economy of different cuts may be calculated for any given scale of prices.

TABLE SHOWING COST OF LEAN AND OF TOTAL MEAT IN THE VARIOUS RETAIL CUTS AT MARKET PRICES.*

RETAIL CUTS	Retail price per pound of cut, cents	Cost per pound of lean meat in cut, cents	Cost per pound of lean and fat meat in cut, cents
STEAKS			
Porterhouse, hip-bone	25	38.6	28.9
Porterhouse, regular	25	40.2	27.2
Club steak	20	32.1	22.6
Sirloin, butt-end	20	25.3	20.6
Sirloin, round-bone	20	28.3	21.1
Sirloin, double-bone	20	28.7	22.7
Sirloin, hip-bone	20	32.3	24.2
Flank steak	16	19.3	16.0
Round, first cut	15	17.0	15.3
Round, middle cut	15	17.3	15.6
Round, last cut	15	19.3	16.0
Chuck, first cut	12	18.3	14.1
Chuck, last cut	12	15.7	13.1

For typical illustrations of many of these cuts see pages 379-390.

TABLE SHOWING COST OF LEAN AND OF TOTAL MEAT IN THE VARIOUS RETAIL CUTS AT MARKET PRICES.—Continued.

RETAIL CUTS	Retail price per pound of cut, cents	Cost per pound of lean meat in cut, cents	Cost per pound of lean and fat meat in cut, cents
ROASTS			
Prime ribs, first cut	20	40.5	22.9
Prime ribs, last cut	16	26.1	18.8
Chuck, 5th rib	15	22.8	17.3
Rump	12	19.4	12.8
BOILING AND STEWING PIECES			
Round pot roast	10	11.6	10.1
Shoulder clod	10	12.3	10.5
Shoulder pot roast	10	14.3	11.6
Rib ends	8	16.2	9.2
Brisket	8	15.0	8.7
Navel	7	12.8	7.7
Flank stew	7	10.9	7.1
Fore shank stew	7	8.5	7.0
Neck	6	8.5	7.0
SOUP BONES			
Round, knuckle	5	26.3	12.5
Hind shank, middle cut	5	7.5	6.3
Hind shank, hock	5	62.5	26.6
Fore shank, knuckle	5	17.2	12.5
Fore shank, middle cut	5	12.5	9.4
Fore shank, end	5	28.8	20.9

Taking the net cost of the lean meat as a basis of comparison, we learn from these data that the most expensive steaks at the prices given are the porterhouse cuts, followed by the club, sirloin, flank, round, and chuck steaks. Of the different roasts, the first-cut prime ribs are the most costly in terms of lean meat, and the rump roast is the most economical.

The various boiling and stewing pieces furnish lean meat more economically at market prices than either the roasts or steaks; the rib ends and brisket being the dearer cuts of this class, while the neck and shank stews are relatively cheapest. Several of the soup bones are very economical sources of lean meat, particularly the middle cuts of both shanks; and only one of them is extremely expensive, even on this basis.

In general, the wide variation between the various cuts in net cost of lean is remarkable, ranging from 7.5 cents in one of the soup bones to 40.5 cents in a prime rib roast, and up to 62.5 cents in the hock soup bone; the latter, however, being used primarily for its flavoring substance rather than for lean meat. It will be observed, also, that the market prices of the cheaper cuts correspond much more closely to their net cost of lean meat than is true of the higher-priced steaks and roasts.

The net cost per pound of gross meat, or lean and fat combined, varies much less as between the different cuts than does the net cost per pound of lean, because the proportions of total meat are more nearly uniform than the percentages of lean. The various steaks and roasts rank in substantially the same order as to relative economy on this basis as on the basis of lean meat. The rib roasts, however, are considerably more economical as compared with the porterhouse and sirloin steaks when all the edible

meat is considered. The rump shows a very low cost per pound of edible meat, due to the large proportion of fat it contains; and a still further difference is noticed in the case of the rib ends, brisket, navel, flank, neck, and several of the soup-bone cuts. The stewing meats are generally the most economical sources of edible meat at these prices, while porterhouse steaks are the most expensive.

On the whole, the data clearly show that the cheaper cuts of beef are by far the most economical sources both of lean and of total edible meat, including fat and lean.

Methods of Serving Tough Cuts of Meat. These must be cooked so that the connective tissue will be softened; therefore, a long time is necessary. If this were done without water, as in the oven ordinarily, too much water would be lost from the meat. Consequently it is necessary to cook them in water or gravy.

Experiment 82. To prepare a tough cut of meat as a stew.

Directions. Have the meat cut into ½-inch pieces, if possible. Brown these in a little of their own fat, hot. Cover these with water and cook as would be necessary to soften the connective tissue and not toughen the protein. An average time for a stew from a very tough piece of meat is 2½ to 3 hours. If vegetables are to be added, dice them and allow 20 minutes for cooking. Serve with dumplings.

Dumplings are made from ordinary baking powder or soda biscuit dough, using only 1 t fat to 1 c flour, and mak-

ing dough soft enough to drop. Remove meat, so that it will not boil during steaming of dumplings. To prevent sogginess, be careful to drop dough, so far as possible, onto pieces of vegetable or bone rather than into the gravy. Cover the vessel tight and steam about 12 minutes.

Dumplings may be cooked in a steamer placed over the gravy. Thicken gravy with enough flour to make it of the same consistency as for creamed vegetables. Season and serve over meat and dumplings.

Experiment 83. To prepare a pot roast.

Directions. Using the front or face of the rump, prepare a pot roast. Sear the meat until brown all around. Half cover with water. If entirely covered, the gravy is too dilute. Cook it over a simmering burner on the back of the stove, or in a fireless cooker, so that there is no motion in the water. One to 1¼ hours to a pound is necessary, according to the toughness of the meat; if from the front of the rump, an hour is sufficient; if from the face, an hour and a quarter. After half of the time has elapsed, turn the roast. If a thermometer is used, cook to a temperature of at least 65° C. or 149° F. in the center. A temperature of 62½° C. or 144° F. maintained for 20 minutes kills all bacteria and parasites except those which form spores. If spore-forming bacteria are present, the meat should be destroyed. These bacteria occur only in lockjaw and anthrax. The latter is a disease almost unknown in this country. If better done meat is desired, it may be cooked for a longer time. Note the appearance of the meat at 65° C. so that this may be used as a test when no thermometer is at hand.

Croquettes are a satisfactory way of using small amounts of left-over meat. Breakfast foods, left-over potatoes, and other vegetables may be used with the meat.

Experiment 84. To prepare meat croquettes.

Directions. The meat, chopped or ground, is added to half its quantity of a thick sauce (4 T flour to 1 c liquid). Variations may be made as follows:

a. Liquid may be ½ meat stock or broth and ½ milk.

b. Liquid same as *a*, flour browned before liquid is added, thus giving a less raw flavor than with unbrowned flour.

c. Liquid ½ water, ½ tomato juice. This is good when meat is particularly lacking in flavor, as when soup has been made from it.

d. A thinner tomato sauce may be poured over the croquettes. Roll croquettes in flour, then egg, and then finely powdered cracker crumbs and fry them in deep fat.

Question. 1. What temperature will be used for croquettes? Cf. *Exp. 58.*

Experiment 85. To prepare mock duck.

Directions. Use a flank steak. Make 2 c of dressing from bread crumbs well seasoned with chopped onion, salt, pepper, and a little chopped suet or other fat. Place this on the steak and bring the ends of it together. Tie or sew. Brown it in the oven or in a skillet. Cook in water until tender. How would you regulate the heat? With the meat only on the surface of the roll like this, the time ranges from 45 minutes to an hour for the entire cooking. The meat may be browned after cooking.

Experiment 86. To prepare corned beef hash.

Directions. Cook corned beef (in a fireless cooker) as you did a pot roast. Remove gristle and bone and chop or grind the meat. Dice some boiled potatoes and mix equal quantities of meat and potato. Season with salt and pepper. This hash may be browned in a skillet or prepared as a baked hash, using a little water to moisten. For baked hash, the meat may be mixed with one-half as much medium

white sauce. Put in an oiled baking dish, sprinkle with bread crumbs and bake in a moderate oven until thoroughly heated.

Experiment 87. To prepare Hamburg steak and meat loaf.

Directions. a. Have meat cut fresh from the round and ground with a little suet. Form it without packing into one large steak. The common method of cooking this steak in small balls gives a very compact mass, while in the large steak the meat is much softer. Broil, if possible; otherwise, pan-broil.

b. Prepare Meat Loaf. Use:

1½ lbs lean veal	6 crackers
¼ lb lean pork	½ t salt
1 T lemon juice	

Bake 1½ hours in a moderate oven (185° C. or 365° F.), basting with melted pork fat mixed with hot water.

Experiment 88. To prepare gelatin from bone.

Directions. Soak a chicken bone, leg preferably, in vinegar. This dissolves the ash. What is left is ossein. What are its characteristics? Cook this in water.

NOTE. It takes several days for the chicken bone to soak sufficiently.

Experiment 89. To prepare soup.

Soup is a material composed largely of water, with flavoring material, protein, fat, gelatin, and ash.

By analysis, 1 pound beef and about ½ pound veal bones gave about 1 pint of strong soup, which contained by weight:

95.2% water	1.8% extractives
1.2% protein	.3% ash
1.5% fat	

If savory herbs are added, more water may be used so that it forms as much as 98% of the soup.

Soups are only slightly nutritious. Their stimulating effect on the nervous system is due to their extractives.

Extractives. Extractives are substances found in solution in the juice of the meat. Their name is derived from the fact that they can be extracted from meat through the use of boiling water.

From Farmers' Bulletin 34.

The term meat extract is commonly applied to a large number of preparations on the market of very different character. They may be conveniently divided into three classes: (1) True meat extracts: Liebig's Extract of Beef is well known; (2) meat juice obtained by pressure and preserved, compounds which contain dry pulverized meat and similar preparations, and (3) albumen or albumose preparations, commonly called predigested foods.

The true meat extract, if pure, contains little else besides the flavoring matters of the meat from which it is prepared, together with such mineral salts as may be dissolved out. It should contain no gelatin or fat. Further, it contains no true protein because of the way it is made, the protein being coagulated during the heating. It is, therefore, not a food at all, but a stimulant, and should be classed with tea, coffee, and other allied substances. It should never be administered to the sick except as directed under

competent medical advice. Its strong, meaty taste is deceptive, and the person depending upon it alone for food would certainly die of starvation. Such meat extracts are often found useful in the kitchen for flavoring soups, sauces, etc. Broth and beef tea, as ordinarily prepared in the household, contain more or less protein, gelatin, and fat, and therefore are foods as well as stimulants. The proportion of water in such compounds is always very large. The preserved meat juice and similar preparations contain more or less protein, and therefore have some value as food. The third class of preparations is comparatively new. The better ones are really what they claim to be—predigested foods. They contain soluble albumoses (peptoses), etc., which are obtained from meat by artificial digestion. Their use should also be regulated by a physician.

Gelatin. Gelatin comes from the connective tissue of meat and from bone. The flesh of older animals yields more gelatin than the bone, but the opposite is true of the younger animals. Therefore, a good combination for soup is a piece of beef meat and veal bone.

Experiments made at the University of Illinois have proved that meat put into cold water and then set immediately over the fire loses no more of its constituents than meat put into hot water. If a well-flavored soup is desired, it is therefore necessary to soak the meat in cold water for half an hour.

What would be the effect of the size of the pieces upon the flavor of the soup?

The amount of water used for soup that is not dilute in its flavor is about 3 c to 1 lb of meat and bone.

The flavoring materials of soup are volatile bodies. Recall the odor of soup or meat while it is cooking. If the water is allowed to boil, more of these pass off.

1. What would be the effect upon soup?

2. What would be the effect upon the meat of letting the water boil?

Test the scum which forms on soup for protein. When should this scum be removed? The time of cooking depends upon the toughness of the meat. Refer to previous work for time. Vegetables and cereals may be added and be cooked in the soup for the required time.

The fat may be removed by cooling, then skimming after the soup is cold. Reheat to serve.

For a clear soup, either strain through a cloth, or clear by means of egg. For the latter method, use the white of one egg and its shell to 2 qts soup. Beat the white enough to break it and crush the shell. Add to the cold soup, then slowly bring it to the boiling point.

Explain the use of egg to clear soup.

Directions. Make soup from beef and a knuckle of veal, flavoring with carrots, turnip, onion, and celery. In order to improve the flavor and the color, some of the meat may be seared in fat, or scorched caramel may be used when it is highly diluted to improve the color without affecting the flavor. The soup strained is known as bouillon.

When some veal is added and the flavoring is more decided, soup is called consommé. This, too, is served clear.

Soup stock made from meat, whether from the darker meats, as beef or mutton, or from the lighter meats, as from

chicken or veal, may be served leaving the vegetables in the soup. Likewise, rice, barley, and macaroni may be added. These soups are known by the flavoring used; *e. g.*, noodle soup.

Experiment 90. To prepare the tender cuts of meat.

Discussion—Oven Roasts. The following cuts from different animals are suitable for this purpose:

Beef. The first seven ribs next to the middle of the animal are called the prime ribs. This is the most expensive roasting meat, considering the amount of lean meat. The front of the rump from a prime animal also makes a good oven roast.

Mutton. Loin or Leg. The latter takes a longer time to cook because it is tougher meat.

Lamb. Leg or Shoulder.

Pork. Rib, Loin, or Shoulder. The hind portions are made into hams.

Veal. Leg, Loin, or Rib.

To Prepare a Beef Roast. Rub in salt and pepper, if desired, and then dredge the roast with flour. If the meat is deficient in fat, some trimmings of it should be added. The surfaces must be seared in hot fat. This is most easily done directly over the fire before the meat is placed on the rack in the pan. A little water should be added to keep the juices and fat and flour from burning. To finish cooking after the roast is on the rack, place it in an oven of about 185° C. If the pan has a lid on it, the roast need not be basted. If it is uncovered, the liquid from the pan should be dipped over it every half hour or so. The time required depends upon the shape and weight of the roast. A fair allowance is from 20 to 25 minutes per pound. Meat should have an inside temperature of at least 65° C. to insure the killing of all bacteria and parasites.

Gravies should be tasty and of the consistency of thick cream. To make gravies from roasts, remove some of the fat from the bottom of the pan, add flour in the proportion of 1 T to 1 c of gravy. Cook the flour in the remaining fat and juices, and then add the water. From 1½ to 2 c of gravy may be made from a 3 to 5 lb roast. To make more gravy would reduce the flavor. Salt will have to be added to the gravy. Additional flavors of carrot, bay leaf, onion, etc., may be given by putting these into the pan at the beginning of the roasting, straining the pieces out before serving.

2. *Veal Roast.* Strips of fat salt pork are often placed over a roast of this kind, which is deficient in fat and flavor. Carrots, celery, and other vegetables may be added. It is well to allow half an hour to the pound for a veal roast.

3. *Leg of Mutton or Lamb* has a caul of fat encasing it. This should be removed to prevent a strong flavor. Mint sauce or currant jelly is served with roast lamb or mutton; caper sauce with "boiled" mutton.

4. *Pork.* Apples, either baked, fried, or as sauce, seem to be an almost necessary accompaniment of roast or broiled pork.

5. *Steaks.* In beef, these consist of the T-bone or club steak (the one between the ribs and the porterhouse), the porterhouse, and the hip-bone sirloin. Those cuts of sirloin which are back of the hip-bone are not so desirable, although they may be used. It is important to know that in many markets there is no difference in price between the hip-bone cuts and those less desirable. Steaks should be cut at least one inch thick in order that they will not be dried out in cooking.

Steaks may be broiled either in a frying pan or by being exposed to the blaze. Pan-broiling is cooking in a hot frying pan without any fat in it except that which comes from

the meat. The fire is kept high until the meat is seared on the two sides, and then it is turned low until the meat is done. In the other method, the meat is placed on a rack which has a pan below it to catch the drippings. Proceed as in pan-broiling.

6. *Chops.* There are two kinds of chops: Loin chops, which correspond with the porterhouse and sirloin steaks of beef, and rib chops. These are usually the same price per pound, but there is more bone in the rib chop than in the loin. The loin chops have a bit of tenderloin in them which the rib chops do not have, which is another advantage. A Frenched chop is a rib chop which has the meat and skin scraped off the bone for two or three inches. The principle used in broiling steaks applies to chops.

It seems desirable to use a longer time for cooking veal. Therefore, it cannot be satisfactorily broiled or pan-broiled. Breaded veal chops may be sautéd until they are brown, then covered and cooked at a low temperature until tender. Veal chops or steak, coming from the round, may be browned, then cooked in a covered dish in a moderate oven with a little water or milk.

Prepare one kind of chop and serve it with creamed potatoes.

A pork tenderloin which weighs from 3/4 to 2 lb is sometimes cut into 1½-inch pieces and then flattened with a cleaver. Although the price per pound is high, there is no waste, and tender meat is assured.

Cold Storage Meats. Home slaughtering is rarely done by butchers now. The big meat centers where thousands of animals are killed, dressed, and stored, have produced so much better meat that in spite of a few lingering misgivings about cold storage, that

practice is steadily increasing. The following extract from an article describes this process and the results.

In order to supply the market more evenly during all the year with eggs, meats, fruits, and vegetables, cold storage plants have been erected in the larger centers of population. In these, foodstuffs may be kept for months without injury, thus avoiding wasting when the food is more plentiful than is needed.

Meats which are to be put into cold storage should not be allowed to remain in a temperature above freezing for any length of time previous to storing. Neither should they be kept in a warm place after they have been taken from storage before they are eaten.

Bacteria do not multiply at from 32° F. to 10° F. In ice they die gradually, so that it seems reasonable to suppose that they would do the same in frozen meats. Meats have been kept thus for 12 months without the sign of chemical change. To develop the finest flavor, meats, especially steaks and roasts, are hung in a temperature of 32° F. to 40° F. for about 30 to 60 days before selling. Changes take place due to bacteria and molds. This is called "ripening."

To just what point ripening should go on depends upon the flavor desired. It includes simply the early

REFERENCE. P. G. Heineman, *Popular Science Monthly*, Vol. 81.

stages toward decomposition or decay. Properly ripened meat is harmless.

Freezing does not change meat chemically but the freezing of water in the meat breaks the cells more or less, and by thus loosening the structure, makes easy the invasion by bacteria. Fish contains more water than meat and has a looser structure; therefore, it spoils even more readily.

It has been definitely proved that undrawn cold storage poultry is less contaminated by bacteria than drawn. In drawing, the tissues are torn and infected by bacteria from the intestines.

Both meat and poultry should be killed at the packing house to insure the best care. If poultry is shipped it should not be allowed to become wet by contact with ice or water. This softens the skin and makes bacterial invasion easier. When frozen meat, poultry, or fish is thawed, it should be done slowly in order to break as few cells as possible. Poultry is sometimes delivered to the customers frozen, undrawn, in sealed paraffin boxes. It should be kept in a house refrigerator for about two days to thaw.

Legislation concerning cold storage plants should not restrict the time which foods may be kept there. This is unjustifiable from two points of view: First, the wholesomeness of the food is not impaired, as proved by experiments; second, the food supply will not be sufficient to meet the demand if the time is

limited. Legislation, however, should provide for government inspection of the warehouses in regard to ventilation, cleanliness, temperature, and construction, and for the inspection of all foods before they are put into cold storage.

Ptomaine Poisoning. Ptomaine poisoning is not due to tin cans, as is generally thought. It is due to the products formed in the food by some kinds of bacteria. Ptomaines are found only in protein foods; *e.g.*, milk, meat, fish, etc. Cases of poisoning due to bacteria themselves often occur from eating these foods. Canned meats and fish are particularly likely to produce illness from bacteria or from their products, ptomaines. The temperature applied in cooking is not sufficiently high to kill the bacteria in the centers of the cans. The small amount of water in the cans makes thorough heating more difficult.

If ptomaines have been formed in foods, heating may break them into new harmless substances or it may not. Only a chemical analysis will determine this. These and many other infections which are not those producing putrefaction frequently cannot be detected by any outward sign, or by the taste.

Sausage is often subject to bacterial infection and decomposition since it is not made from choice cuts, but often from scraps.

Therefore, the only safe thing to do is to make sure that the meat has been properly cared for and to

refrain from buying those kinds of meat in the preparation of which there is chance for carelessness.

REFERENCES. "Mutton and Its Value in the Diet," Farmers' Bulletin 526, 1913. "Economical Use of Meat," Farmers' Bulletin 991, 1910. "Cooking Meat," Experiment Station Work 25, Farmers' Bulletin 193, pp. 29-31. "Meat, Composition and Cooking," Farmers' Bulletin 34.

CHAPTER XVIII

GELATIN

BRANDS—COST—METHODS OF DISSOLVING—GELATIN DESSERTS

Gelatin is one of the by-products of the packing-house industry. It is put upon the market in sheets, in shreds, and as powder. Sheet gelatin may be bought at drug or grocery stores at prices ranging from 50 to 90 cents per pound. It is much more expensive in the other forms.

Fill out the following table:

Kind of Gelatin	*Cost per pkg.*	*Wt. per pkg.*	*Cost per lb.*	*No. qts jelly*
Cox's	......	......	......	......
Knox's	......	......	......	......
Plymouth Rock.	......	......	......	......
Jello	......	......	......	......
Sheet	......	......	......	......

What is the cheapest gelatin per pound?

Weigh 1 T granulated gelatin. How many sheets of gelatin are equal to this?

Experiment 91. To determine the best method of dissolving gelatin.

Directions. Use $\frac{1}{3}$ c water and $\frac{1}{2}$ t gelatine.

a. Put on the gelatin enough cold water to separate the particles, then add the remainder of the liquid, boiling hot.

b. Put $\frac{1}{2}$ t gelatin into $\frac{1}{3}$ c boiling water. Stir over fire until gelatin is dissolved.

c. Put cold water onto gelatin, then bring to a boil. Boil until the gelatin is dissolved.

d. Use the amount of sheet gelatin which corresponds in weight to the granulated. Fold the sheet so that it can still be grasped with the hand, and rub it around on the bottom of the pan of boiling water. It dissolves quickly. When it has dissolved so much that it can no longer be held in the hand, stir it. Save this for *Exp. 92.*

Compare the time needed to completely dissolve granulated gelatin with that needed to dissolve sheet gelatin.

Conclusions. 1. The best method of dissolving granulated gelatin.

2. Considering cost and labor in preparation, which is the cheapest gelatin to use?

Experiment 92. To determine proportions for different types of gelatin desserts.

Discussion. There are four classes of gelatin desserts:

1. A clear jelly flavored with fruit or pulp or both.

2. A clear jelly in which the flavoring composes the larger part of the liquid; *e.g.*, coffee jelly.

3. Sponges, which are jellies and custard jellies into which are beaten, as the jellies begin to stiffen, the whites of eggs, one to each cup of jelly. When custards are used, these are called Spanish creams.

4. To *1* or *2* may be added whipped cream, making a Bavarian cream. The proportion of cream used varies from $\frac{1}{8}$ to $\frac{1}{2}$ c, before whipping, to each cup of jelly.

NOTE. Cream doubles its volume in whipping.

Proportions of ingredients for Classes *1* and *2*:

Liquid	*Gelatin*	*Sugar*
Lemon, 2 c (5 parts water, 1 part lemon juice)	1½ T	½ c
Orange, 2 c (1¼ c water, 1½ T lemon juice, ⅝ c orange juice)	1½ T	½ c
Pineapple, 2 c (1¼ c pineapple, 1 T lemon juice, ⅝ c water)	1½ T	½ c
Strawberry, 2 c (1¼ c crushed strawberry or juice, 1 T lemon juice, ⅝ c water)	1½ T	½ c
Coffee, 2 c (1¼ c coffee, ¾ c water)	1½ T	3 T
Grape juice, 2 c (1¼ c grape juice, 1 T lemon juice, ¾ c water)	1½ T	¼ to ⅓ c

Fresh pineapple contains an enzyme which liquefies gelatin. Therefore, the pineapple must be cooked to destroy the enzyme before it is used with gelatin.

CHAPTER XIX

POULTRY AND FISH

SELECTION—PREPARATION—COOKING

Poultry. Since the age of poultry determines its toughness and therefore the methods by which it should be cooked, or the time required for cooking, a test for age is important. To test the age of poultry, press the breast bone. If it is pliable like cartilage, the chicken is young. The flesh of good poultry should give evenly when pressed. The skin should be smooth and free from pin feathers. A skin looking drawn or stretched means that the fowl has been scalded before picking.

COMPOSITION OF POULTRY.

	Indigestible Material	*Water*	*Protein*	*Fat*	*Ash*	*Fuel Value per Pound*
Chicken	1.2	68.4	21.2	8.4	.8	780 calories
Turkey	2.2	57.4	21.5	.8	.9	1,195 calories
Duck	2.	61.1	17.8	18.1	1.	1,125 calories
Goose	1.8	54.	16.1	27.3	.8	1,485 calories

From the composition of poultry, what should be the temperature in cooking it? Compare its nutritive value with that of beef and veal. What methods should be used for cooking old chickens? Geese and other kinds of poultry are prepared according to the same principle.

Experiment 93. To prepare a chicken for roasting. When roasting is the only process of cooking, what must be the age of the fowl?

Directions. As a group experiment, dress and draw a chicken. Prepare stuffing. Roast as other meat, allowing 20 minutes to the pound.

STUFFING

2 c bread crumbs	Pepper
1/4 c melted butter	Salt
Sage (if desired)	2/3 c boiling water
Celery salt	Minced giblets

For a dry dressing, use less water. Melt fat in water and pour over crumbs to which seasoning has been added. A very old chicken may be roasted if it is first cooked in water until tender.

Experiment 94. To prepare fricassee of chicken. *Directions.* Cut up the chicken, dredge with flour and brown it in hot fat. Cook it until tender in water enough to half cover it. The time depends upon the toughness of the chicken. Thicken and season gravy and serve over chicken. What temperature will you use in cooking? What aged fowl may be used for this? Why?

Make a list of other methods of cooking poultry.

Fish. In selecting fish see that the flesh is firm and the eyes bright. The latter is not always a possible test, however, because the eyes are not always to be seen.

REFERENCES. "Poultry as Food," Farmers' Bulletin 182. "The Comparative Rate of Decomposition in Drawn and Undrawn Market Poultry," Bureau of Chemistry Circular 70.

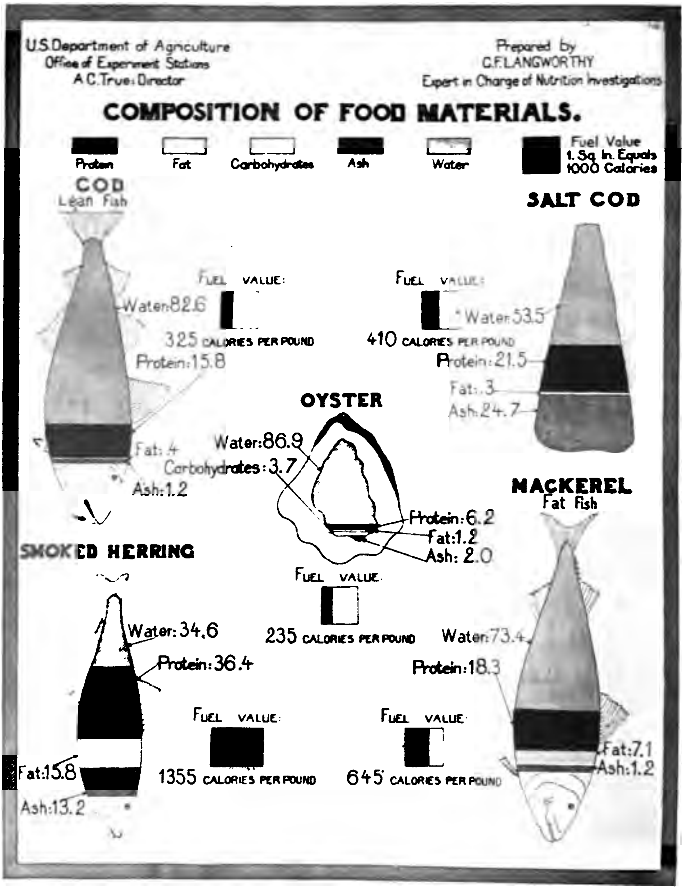

U.S. Department of Agriculture
Office of Experiment Stations
A.C. True: Director
Prepared by
C.F. LANGWORTHY
Expert in Charge of Nutrition Investigations
COMPOSITION OF FOOD MATERIALS.
Protein
Fat
Carbohydrates
Ash
Water
Fuel Value 1. Sq. In. Equals 1000 Calories
COD
Lean Fish
Water: 82.6
Protein: 15.8
Fat: .4
Ash: 1.2
FUEL VALUE:
325 CALORIES PER POUND
SALT COD
FUEL VALUE:
410 CALORIES PER POUND
Water: 53.5
Protein: 21.5
Fat: .3
Ash: 24.7
OYSTER
Water: 86.9
Carbohydrates: 3.7
Protein: 6.2
Fat: 1.2
Ash: 2.0
FUEL VALUE.
235 CALORIES PER POUND
MACKEREL
Fat Fish
Water: 73.4
Protein: 18.3
Fat: 7.1
Ash: 1.2
FUEL VALUE.
645 CALORIES PER POUND
SMOKED HERRING
Water: 34.6
Protein: 36.4
Fat: 15.8
Ash: 13.2
FUEL VALUE:
1355 CALORIES PER POUND

Plate 21.

Fish, with the exception of salmon, contains less fat than other forms of meat. Therefore, fat should be added either in the sauce or in the form of butter or bacon.

Experiment 95. To determine the effect of water at different temperatures upon the amount of material lost from fish and the texture of the fish when cooked.

Directions. *a.* Put a small piece of fish into boiling water. Boil it until it has lost its raw appearance.

b. Put fish into cold water. Bring it to the boiling point, as in *a.*

c. Put another piece into boiling water and cook it at 85° C., 185° F., or in water in which there is no movement.

Conclusions. 1. Compare the dryness and the amount of material lost in *a, b,* and *c,* and explain.

2. Is fresh fish ever tough? Why?

3. How does the temperature used compare with that used in other foods relatively high in protein?

Experiment 96. To prepare sautéd fish.

Directions. Dredge fish with flour and sauté it in hot fat until it has lost its raw appearance. Serve with sliced lemon.

Experiment 97. To prepare baked fish.

Directions. Stuff the fish. Sew or skewer, and place drippings or insert pieces of bacon on top of the fish. Dredge with flour. Lay the fish on strips of cloth so that it may be removed from the tin without falling apart. The fish may be baked on a plank, in which case the cloth does not need to be used. Bake it until well browned. This takes from 20 to 30 minutes, according to the size of the fish.

NOTE. When a plank is used the space not covered by the fish should be covered with salt to prevent charring of the wood.

STUFFING

1 c crumbs, cracker and bread	1/4 t salt
1/4 c melted fat	1/8 t pepper
1/4 c hot water	A few drops of onion juice

Experiment 98. To prepare sauces to serve with fish. *Directions.*

a. DRAWN BUTTER SAUCE

1/3 c butter	1 1/2 c water
3 T flour	1/2 t salt
1 T lemon juice	1/8 t pepper

Melt the butter, add flour with seasonings, and pour hot water on gradually. Boil, then add lemon juice.

b. HOLLANDAISE SAUCE

1/3 c butter, or {1/2 butter, 1/2 oleomargarine}	1 1/2 T lemon juice
	1/4 t salt
	1/2 ss cayenne pepper
Yolks of two eggs	1/2 c boiling water

Cream the butter, add the yolks, and beat. Add salt and pepper. A few minutes before serving, add the boiling water. Cook it slowly until it is of the consistency of a custard. Add lemon juice last, so as not to decrease the thickening power of the eggs.

Experiment 99. To prepare creamed codfish.

Directions. After picking apart the salt codfish, soak it in warm water until some of the saltiness is gone. If time is limited, the fish may be cooked in water as any other fish until softened. Add the fish to the sauce. Serve with baked or mashed potatoes.

Experiment 100. To prepare codfish balls.

Directions.

$2\frac{1}{2}$ c potato	1 egg
1 c codfish	$\frac{1}{2}$ T fat

Prepare the codfish as above.

Cook potatoes in boiling water until they are soft. Shake over the fire until dry, and mash. Add fish, beaten egg, butter, and seasoning. Fish balls may be dipped in flour and shaped, or may be dropped from a spoon into the hot fat. The latter makes a less compact ball.

Shell Fish. The chief shell fish used for food are oysters, clams, scallops, crabs, and lobsters. The last two belong to a different group of fish from the first three and are treated differently in cooking. Both crabs and lobsters are cooked in the shell and are still alive when put into the water. If allowed to die before cooking they are not good to eat.

To cook either crabs or lobsters, plunge them into boiling water and cook at the proper temperature for about 20 minutes. Compare *Experiment 95* for temperature.

Oysters are probably the most commonly used shell fish on the market. They are in season from September to May, and are served either raw or cooked. When not carefully cooked, they are often tough.

Experiment 101. To determine the best method of cooking oysters.

Directions. a. Place an oyster in cold water. Heat slowly. Notice any change which takes place in the size

and shape of the oyster, and the temperature at which it occurs. Note temperature of water when edges of oyster begin to curl. This is the point at which they are ready to serve.

b. Cook an oyster in boiling water until the edges curl as in *a.*

1. Compare the texture and size of oyster in *a* and *b.*
2. What is the best cooking temperature for oysters?

Prepare creamed, fried, and scalloped oysters.

Fried Oysters. To prepare fried oysters, season with salt and pepper, dip in flour, egg, and cracker crumbs, and fry in deep fat until brown.

Scalloped Oysters. Scalloped oysters are prepared by mixing oysters with bread and cracker crumbs, moistening with a little of their liquor and a little milk or cream, and seasoning with melted butter, salt, and pepper. To 1 pint of oysters, use 2 c cracker crumbs or bread and cracker crumbs mixed.

REFERENCES. "Fish as Food," Farmers' Bulletin 85.

CHAPTER XX

SALADS

SALAD DRESSINGS—PREPARATION OF SALADS

Experiment 102. To make a French dressing.

Oil and acid mix slightly better than oil and water. However, the resulting mixture lasts for only a short time; therefore, it is called a temporary emulsion. French dressing is such an emulsion. Compare fat in milk.

3 T oil	¼ t salt
1 T vinegar or lemon juice	⅛ t pepper

Mix thoroughly before using.

If this dressing is mixed in a dish in which there is a piece of ice, the emulsion is formed more readily.

Experiment 103. To prepare mayonnaise dressing.

Mayonnaise dressing is a more permanent emulsion than French dressing. The oil and the acid are held together by the protein of the egg. Either the yolk or the white or both may be used. The white, however, makes a less stiff dressing than the yolk.

¼ t mustard	1 egg yolk
½ t salt	1 to 2 T vinegar or lemon juice
1 c oil	

The amount of acid depends on the material upon which the dressing is to be served.

Directions. Add the seasoning to the egg. Add the oil drop by drop, beating constantly until a very thick mixture

is formed. Now add the acid. Failure to add acid at this time is likely to cause the dressing to separate again. The oil may be added in larger quantities, as much as a tablespoon at a time, after this. If the dressing becomes separated, use another egg, adding the separated dressing to it very slowly. The use of a turbine egg beater greatly hastens the mixing of this dressing. It is a great convenience, if mayonnaise is kept on hand, to start the new supply with some of the old, stiff dressing.

Experiment 104. To prepare cooked dressings.

A less expensive dressing and one which can be made without oil is a cooked dressing.

Directions.

PROPORTIONS

⅓ c vinegar	2 T flour
⅔ c water	4 egg yolks
1 t mustard (French)	1 T sugar
½ t salt	2 T butter or oil

Make a white sauce out of the water, vinegar, seasoning, and flour. Boil it, then add the yolks and cook until the eggs have thickened. What temperature? The fat may be added at any time. The yolks of eggs should not be beaten or some of their thickening power will be lost. If a less sour dressing is desired, use less vinegar and make up the deficiency in liquid with water.

To make a cheaper salad dressing, substitute 1 T flour for each egg yolk omitted. What would be the effect upon the flavor should only 2 eggs be used and flour substituted for the others?

Experiment 105. To prepare salads.

Salads are made of vegetables, fruits, meats, eggs, nuts, cheese, etc., in various ways and combinations. They are always served cold.

Salads are valuable ways of serving food, because:

a. They afford opportunity for use of small amounts of left-over material.

b. They use such foods as lettuce and other greens containing ash. These greens, cooked, would be rather flavorless.

c. They are appetizing.

Fruit and vegetable salads are frequently mixed with French dressing before the mayonnaise or cooked dressing is put over them. This is termed marinating.

Make a list of materials of different kinds suitable for salads. Suggest combinations which would be good.

Prepare a salad.

CHAPTER XXI

FLOUR

Manufacture. Although flour is logically studied with the cereals, its use in batters and doughs involves so many other materials that it was thought better to leave it until this time.

The different grades and varieties of wheat make flour containing different proportions of starch and gluten, as the chief protein is called. Pastry flour is made from wheat containing a larger quantity of starch and less of gluten. From the harder wheats, containing a greater proportion of gluten than the softer wheats, bread flour is made.

As wheat is milled, the processes are as follows:

1. The wheat is screened and cleaned.
2. Passed between corrugated rollers, kernels partially flattened and slightly crushed. Called the first break. A small amount of flour, break flour, separated from the crushed kernels by sieves.
3. Second break. Kernels more completely flattened. Meal-like flour particles partially separated from the bran. Products of these breaks or crushings are called first and second middlings, and look like Cream of Wheat.
4. Middlings passed over rolls more and more closely set. Products finer and finer. Bran particles gradually removed.

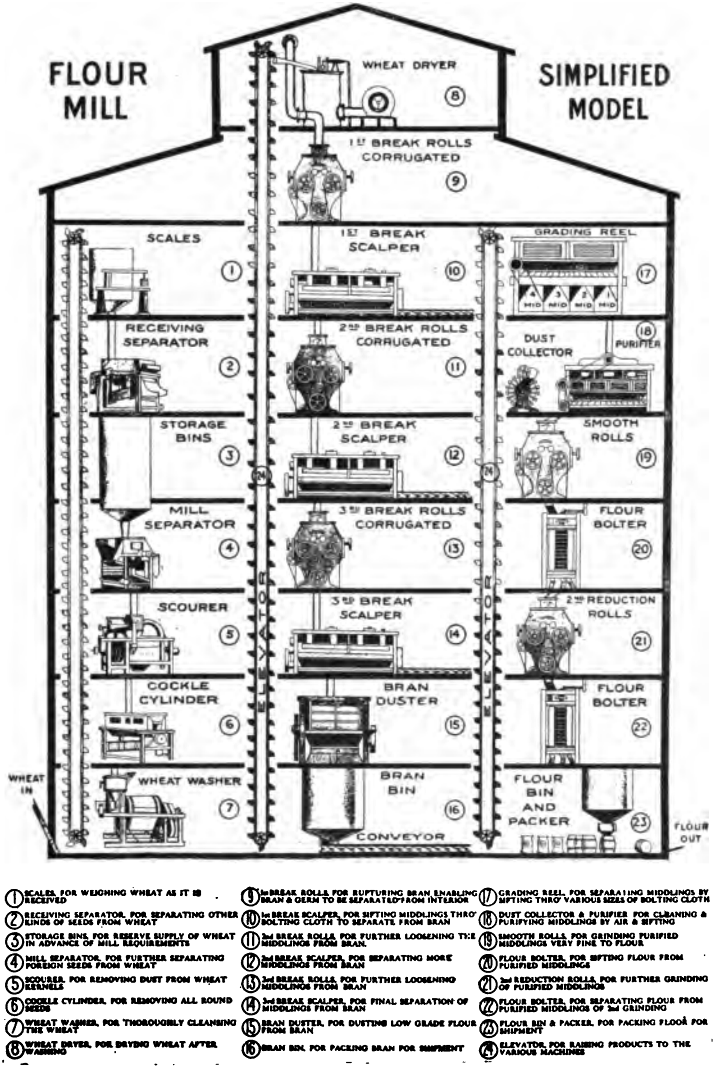


Plate 22.—Shows the successive processes in making flour. (Courtesy of the Washburn-Crosby Co.)

5. After the last break the flour is passed through fine bolting cloth. This last product is patent flour. Low grade flours are made from the middlings without the removal of the branny particles.

Graham flour is, strictly speaking, the entire grain ground to a powder without sifting.

Entire wheat flour, as it is called, contains less of the kernel than graham flour. Three of the five layers of bran are removed, making the finished product less coarse than graham flour. It is often really low grade flour from which the germs, the embryo of the wheat, have not been removed. Whenever the germ is present, the fat in it is likely to become rancid and spoil the taste of the flour.

Only flours from wheat and rye are used in bread making. Although some of the other cereals contain as much protein as these, the form of that protein is different. The principal proteins in wheat flour are gliadin and glutenin. The gluten, seen in the balls of washed flour, is formed from these two proteins when the flour is wet. Gliadin is a sticky protein which holds in the gas as the dough rises. If gliadin is washed from the flour, the loaf of bread made from that flour does not rise, and holds together like putty. Gliadin and glutenin must be present in such proportion as to make a gluten neither too sticky nor too putty-like.

It is difficult for the householder to judge accu-

rately of a new sack of flour. Something can be told, however, by observing the following tests:

Color. Good flour should be pure or creamy white. Flour is generally slightly bleached by electrical action. This is perfectly harmless and seems to be required to make flour to suit the public taste. It is impossible to bleach low grades of flour so as to disguise them for a standard patent flour.

The Odor. Flour should smell sweet and nutty. It should show no sign of mustiness or acidity, or odor absorbed from other source.

Water Absorbing Power. A good flour should absorb from 60% to 65% of its weight of water to make a dough of standard consistency. A low absorbing power means low gluten content, a poor bread flour. A dough might be made from a flour of known quality and the one unknown, using a given amount of water in each case and comparing the doughs. There is now very little variation in the different lots of flour of the same brand. A new brand may need a slight adjustment in the amount of liquid to be used with it.

Rye flour does not make so light a loaf as wheat flour, due to a difference in the character of gluten in it. Entire wheat and graham flour each makes a loaf less light than the same quantity of patent flour. Anyone of these three flours may be mixed

with some white flour if a lighter loaf is desired, but the flavor is impaired.

Bran mixed with a very little flour is used for making muffins, particularly for people who are troubled with constipation. It has been thought that the coarse particles irritate the digestive tract, thereby causing movement. It is now known that if bran is washed free from its ash it does not have this laxative effect. Therefore, it must be the ash and not the coarse particles which is desirable in such cases.

Experiment 106. To determine the characteristics of the chief constituents of flour.

Directions. Moisten ¾ c flour with about 3 T water, or enough to make a stiff dough. Knead well. Work gently in a bowl of cold water until all the starch is out, changing the water frequently. How will you determine when all the starch is out?

Note the color and consistency of what remains. This is the protein of flour, called gluten.

a. Divide into three parts. Have two parts moist and squeeze the third as dry as possible. Bake a dry one and a moist one in a moderate oven (195° C. to 210° C. or 385° F. to 410° F.). Bake the other moist one in a hot oven (225° C. or 437° F.).

Let two or three of the class remove the balls from the moderate oven when the gluten rebounds but is not firm when pressed with the fingers. Continue baking the others until they are firm to the touch.

Questions and *Conclusions.* 1. Compare the size of the wet ball and the dry ball from the moderate oven.

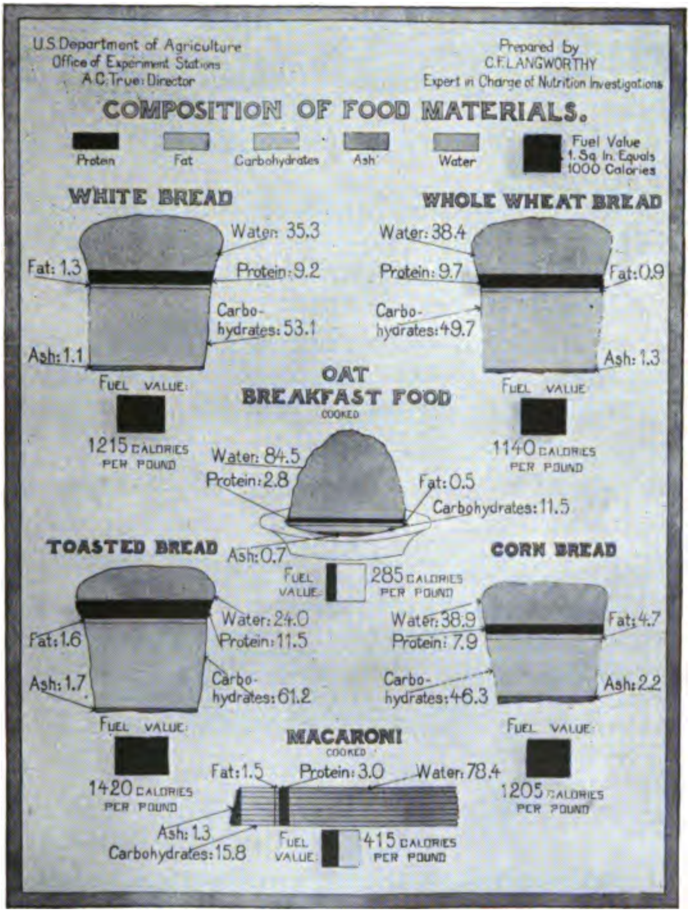

U.S. Department of Agriculture
Office of Experiment Stations
A.C. True: Director
Prepared by
C.F. LANGWORTHY
Expert in Charge of Nutrition Investigations
COMPOSITION OF FOOD MATERIALS.
Protein
Fat
Carbohydrates
Ash
Water
Fuel Value 1 Sq. In. Equals 1000 Calories
WHITE BREAD
Water: 35.3
Fat: 1.3
Protein: 9.2
Carbo-hydrates: 53.1
Ash: 1.1
FUEL VALUE:
1215 CALORIES PER POUND
WHOLE WHEAT BREAD
Water: 38.4
Protein: 9.7
Fat: 0.9
Carbo-hydrates: 49.7
Ash: 1.3
FUEL VALUE
1140 CALORIES PER POUND
OAT BREAKFAST FOOD
COOKED
Water: 84.5
Protein: 2.8
Fat: 0.5
Carbohydrates: 11.5
Ash: 0.7
FUEL VALUE
285 CALORIES PER POUND
TOASTED BREAD
Water: 24.0
Protein: 11.5
Fat: 1.6
Ash: 1.7
Carbo-hydrates: 61.2
FUEL VALUE:
1420 CALORIES PER POUND
CORN BREAD
Water: 38.9
Fat: 4.7
Protein: 7.9
Carbo-hydrates: 46.3
Ash: 2.2
FUEL VALUE
1205 CALORIES PER POUND
MACARONI
COOKED
Fat: 1.5
Protein: 3.0
Water: 78.4
Ash: 1.3
Carbohydrates: 15.8
FUEL VALUE
415 CALORIES PER POUND

Plate 23.

2. What made the balls increase in size? Recall the way in which the loose lid of a tea kettle moves up and down when water is boiling. Explain.

3. How does this help you to explain the size of these balls?

4. Explain the results in those that are taken out before they rebound.

5. How do you account for the result in the hot oven?

6. How does this explain why a loaf placed next to the side of an oven has an uneven top with the higher side toward the center of the oven?

b. As a class experiment, mix ¼ c flour with enough water to make it as moist as the more moist gluten ball.

c. Repeat, using cornstarch.

Bake in the oven with the gluten balls.

Questions. 1. What difference do you notice between *b* and *c* in stirring?

2. How does the starch in the flour affect the size of the ball?

NOTE. In many cook books all recipes in which baking powder is used, call for pastry flour. This differs from bread flour in having less gluten and more starch. This makes a more tender loaf than bread flour in an equal quantity. To substitute bread flour for pastry flour use ⅛ less.

Batters and Doughs. *Experiment 106* shows the function of gluten in producing a light loaf. Gluten has been found to have elasticity like rubber and to harden with heat. Rubber must be pulled in order to stretch. Gluten, likewise, must be pulled or pushed. In batters and doughs there must be something to push the gluten and stretch it. The ma-

terials which will do this are called leavening agents. This series of batters and doughs will be worked out from the thinnest to the thickest, keeping the amount of liquid the same, varying the other ingredients as is required to produce good results.

Experiment 107. To determine an accurate way of measuring flour for batter and dough work.

Directions. *a.* Fill a cup with unsifted flour until it is level. Weigh it. Sift it and fill the cup again. Weigh this cup of sifted flour. Record weights.

b. Repeat *a.*

Conclusions. 1. Compare the constancy of the weights of sifted flour with those of the unsifted.

2. Which is the more accurate method of measuring?

NOTE. The difficulty that people have in remedying imperfect results in batters and doughs lies in the fact that they do not understand the causes for their results. Among these causes are wrong proportions of sugar, fat, and leavening agents, bad mixing, and improper baking temperatures. Many of these difficulties are brought about by inaccuracy of measurement (See *Exp. 1*) or by use of bread flour in the same proportions as pastry flour.

Popovers are made from the thinnest batter.

Experiment 108. To prepare popovers.

Directions. *a.* Determine the effect of an improper proportion of flour.

b. Determine the effect of beating a popover batter.

1. Proportions:

Liquid	*Flour*	*Fat*	*Eggs*	*Leavening Agent*	*Salt*
1 c (includes milk and fat)	1 c	1 t to 1 T	1		½ t

Fat increases the crispness of popovers.

2. Use proportions as in *1*, but decrease flour to 3/4 c.

3. Use proportions as in *1*, but increase flour to 1 1/4 c.

Method of Mixing. Melt the fat in the utensil in which popovers are to be baked. Mix flour and salt, add the milk and egg, avoiding lumps. If a small amount of the fat is put into each cup in which the popovers are to be baked, it need not be poured into the batter. One cup of liquid makes eight good-sized popovers. Individually, make one popover from *1*. Make one from *2* and *3*.

NOTE. In each case use 1/8 of the large quantities. Let the even numbers beat the batter thoroughly, and the odd simply mix it until it is smooth. Parts *2* and *3* of the experiment may be done as group work.

Baking. Use a hot oven (210° C., 410° F.) for from 40 to 45 minutes until popovers are firm to the touch.

Conclusions. 1. How do you detect too great a proportion of flour? Too small a proportion?

2. What do you conclude as to the value of beating?

3. What is the leavening agent in popovers?

Popovers may be cut in half and canned peaches, apricots, or other fruits put into them.

Experiment 109. To prepare cream puffs.

These differ from popovers in containing more fat and egg.

Directions. Proportions:

Liquid	*Flour*	*Fat*	*Eggs*	*Leavening Agent*	*Salt*
1 c water	1 c	1/4 to 1/3 c	2-4	..	1/2 t

Use 1/4 of the quantity. Let even numbers use the proportion of 1/4 c fat, odd numbers 1/3 c fat.

Methods of Mixing. 1. Mix the fat, water, and flour as for a white sauce. Cook until the mass leaves the sides of the pans. Remove from the fire and add the eggs, unbeaten, one at a time. Beat it until it is a smooth mass. Drop the mixture from a spoon upon oiled tins. Place the puffs 1½ inches apart and shape them toward a point at the top. Bake in a moderate oven for from 25 to 30 minutes, depending upon the size.

2. Cream puffs may be mixed as in popovers, but in this case they must be baked in muffin tins.

Baking. Use the same temperature as for popovers. Owing to the thinness of the cream puff batter, it is wise to take one cream puff out when it seems firm to the touch. If this one does not fall, the others may be removed.

This amount of liquid (1 c) will make 8 large cream puffs or 12 to 16 small ones.

Conclusion. What is the effect of different proportions of fat on the result?

Make a filling using the following proportions:

2 c milk	6 T flour
¼ c sugar	2 egg yolks
½ t vanilla or lemon extract	

Mix as you would a cornstarch pudding, adding the eggs immediately after taking from the stove. Chocolate may be added to the filling, using ¼ of a square to 1 pt of liquid, or whipped cream, sweetened and flavored with vanilla, may be used instead of a cooked filling.

Experiment 110. To prepare a cover batter from a popover batter.

Directions. Make a popover batter, using ⅛ of the recipe. Core an apple and slice crosswise ¼ inch thick. Dip the slices into the batter. Does the batter remain on

the apple? If not, add ¼ T more flour. What would this proportion be in 1 c liquid? Fry them in deep fat, using the 60-count test for bread crumb.

Apples or other fruit may be cut into small pieces and put into the batter. Use as much fruit as the batter will cover, then fry. This makes a fritter. When a batter becomes thicker than these are, some additional means must be used to make it light.

CHAPTER XXII

CHEMICAL LEAVENING AGENTS

Baking soda ($NaHCO_3$) is the substance in almost every chemical leavening agent from which a gas, carbon dioxide, is obtained. When this gas is freed from the soda, it is entangled in a batter or dough. When the latter is put into the oven and heated, the gas expands and pushes up the gluten. The problem, then, is to free this gas from the soda. The following experiment will show various methods of doing this:

Experiment 111. To determine the methods of freeing gas from soda.

Directions. *a.* Test vinegar, sour milk, molasses, and cream of tartar with litmus paper.

What is the reaction of each?

In each of the following cases place the substance used in a test tube and note the gas formation when cold and after heating.

b. Soda and cold water. Be careful to distinguish between bubbles from boiling and bubbles of carbon dioxide. If the bubbles continue after removing from the fire, they are gas bubbles.

c. Soda and vinegar.

d. Soda and sour milk.

e. Soda and molasses.

f. 1. Soda and cream of tartar (use dry test tube).

2. Repeat *f*, adding water.

g. Baking powder and cold water.

h. Test *g,* after heating, with iodine.

What is the function of the ingredient found in *h?* Compare the use of this ingredient in salt cellars.

Conclusions. 1. What kind of substances break up soda so as to free the gas easily?

2. What is the source of the gas in each case?

3. Explain the difference between *f 1* and *f 2.*

4. When should the baking powder be added to a thin batter with reference to the time of putting it over the heat?

5. What difference would a soft dough such as biscuit dough make in this regard?

6. Would you keep a griddle cake batter near the stove while baking cakes? Why?

Baking Powders. In the previous experiment, acids were found to free the gas, carbon dioxide, CO_2, from soda. To make baking powders some dry, inexpensive, and harmless acid must be used. Baking powders are classified according to the acid which they contain. Their efficiency, taste, cost, and effect on the body depend upon this constituent.

1. *Tartrate.*
   - *a.* Acid tartaric, or cream of tartar, made by purifying the purplish deposit in wine casks, argol.
   - *b.* amount of carbon dioxide available, 12.58%.
   - *c.* amount of filler, 7.42% to 20%.

     [Recently brands containing no filler have been put on the market. The action is so quick in these, however, that no more carbon dioxide, and perhaps less, seems to be available than where some filler is used.]

d. Residue.

1. Content

Sodium tartrate.

Rochelle salts.

2. Effect on body. If bread or cake were eaten a loaf at a time, some purgative effect might be felt as from a Seidlitz powder. Probably no effect in quantities eaten.
3. Taste. Not noticeable.

e. Chemical reactions.

$$NaHCO_3 + KHC_4H_4O_6 \rightarrow NaKC_4H_4O_6 + CO_2 + H_2O$$
$$2NaHCO_3 + H_2C_4H_4O_6 \rightarrow Na_2C_4H_4O_6 + 2H_2O + 2CO_2$$

2. *Phosphate.*

a. Acid calcium phosphate.

b. Amount CO_2 available, 12.86%.

c. Amount of filler, 26.41%. On account of the rapid action of this kind of baking powder, more filler is considered legitimate in order to prevent loss of gas.

d. Residue.

1. Sodium and calcium phosphates.
2. Effect on body, mildly purgative; no effect in the quantities eaten.
3. Slight taste.

e. Chemical reactions.

$$CaH_4(PO_4)_2 + 2NaHCO_3 \\ \rightarrow CaHPO_4 + Na_2HPO_4 + 2CO_2 + 2H_2O$$

3. *Alum.*

a. Acid generally potash alum; sometimes ammonia alum, which is worse.

b. Amount CO_2 available, 8.1%.

c. Amount of filler, 43.25%.

d. Residue.

Potassium sulphate and aluminum hydroxide. Aluminum hydroxide dissolves in gastric juice and has an astringent effect on animal tissue, hindering digestion. These are the most objectionable powders.

e. Chemical reactions.

$$2KAl(SO_4)_2 + 6NaHCO_3 \rightarrow 2Al(OH)_3 + 3Na_2SO_4 + K_2SO_4 + 6CO_2$$

4. *Mixed.*

a. Acids of *2* and *3*.

Therefore subject to same objections as *3*, modified by the smaller quantity of harmful substances.

Experiment 112. Make a table of baking powders for sale in your markets, showing cost, weight, and class of each brand.

Use equal quantities of baking powder in some definite quantity of a batter or a dough, and determine the relative lightness and the taste of each.

The batter for griddle cakes is thicker than for popovers.

Experiment 113. To prepare sweet milk griddle cakes.

Directions. As a group experiment, bake popover batter as a griddle cake.

Take ¼ c liquid and prepare on this basis a popover batter, using 1 egg to 1 c liquid.

a. Bake a little of this on a griddle. What is the trouble with it as a griddle cake batter?

NOTE. A soapstone griddle is the best.

b. Add another T of flour. Bake another cake from this batter. What is the trouble with this?

c. Add ¼ t baking powder. Bake a cake from this batter. Describe the appearance of the inside of the cake in *b* and in *c*.

d. To determine by the appearance of the top of the cake the time to turn it.

1. Let bubbles form and break.
2. Let bubbles form and not break.

Which gives the lighter cake?

e. Use ¼ of the following proportions:

Liquid	*Flour*	*Fat*	*Sugar*	*Egg*	*Baking Powder*	*Salt*
1 c	1⅛ c	2 T	1 T	1	2 t	½ t

Mix as a popover batter. When will you add the baking powder?

Experiment 114. To prepare fritters and waffles.

a. As a group, using ½ c liquid, prepare a griddle cake batter as in *Experiment 113, e,* but use the proportion of only 1 T fat. Fry a little of this in deep fat. What is the trouble with it? Add scant 2 T flour and increase the baking powder by adding another half teaspoonful. Fry one of these. What temperature would you use?

Proportions. Prepare fritters, using ¼ of the folowing proportions:

Liquid	*Flour*	*Fat*	*Sugar*	*Egg*	*Baking Powder*	*Salt*
1 c	..	0 to 1 T	1 T	1	3 t	½ t

It has been seen that when the amount of flour is equal to the amount of liquid present, that amount of flour is made light by the steam. As the proportion of flour increases, a leavening agent has been found necessary to assist

the steam in pushing up the gluten. This is not true of a cover batter, because it is not intended to be so dry.

Fritters may be varied by the addition of corn or fruit, such as apples, bananas, or oranges.

Mixing. What method?

Frying. Use the 60-count test for the temperature of fat.

b. Prepare waffles, using the same proportion as for fritters, but increasing the number of eggs to 2.

CHAPTER XXIII

BATTERS AND DOUGHS

MUFFINS—GINGERBREADS—SOFT DOUGHS—PASTRY

Use of Sour Milk and Molasses. Since sour milk and molasses each contain an acid which will free gas from soda, it would be extravagant and useless to use baking powder instead of soda. Often the amount of sour milk and molasses is not enough to allow the use of sufficient soda to leaven a batter or dough. In this case both soda and baking powder may be used. If so large an amount of soda is used that the acid present cannot free the gas from it, the baked product tastes of the soda and looks brownish.

Experiment 115. To determine the amount of soda which may be used with sour milk and molasses.

Directions. a. Dissolve ½ t soda in 50 cc. water. (Water has no effect on litmus.) To ½ c sour milk add the soda solution, 10 cc. at a time. Stir. Test with moistened litmus. As soon as enough soda has been added to react with the acid in the sour milk and neither is in excess, neither color of litmus paper is changed. The mixture is then said to be neutral to litmus, or the acid in the milk is neutralized by the soda. When this point is reached, calculate the

amount of soda which may be used with 1 c of sour milk. *b.* To ½ c molasses add ¼ c water. Dissolve ½ t soda in 50 cc. water. Add this solution, a few cc. at a time, to the molasses, until the neutral point is reached.

Calculate the amount of soda necessary to neutralize 1 c molasses.

Do all brands of molasses have the same acidity?

Problem. To determine the relation between the amount of gas given off by baking powder, soda and sour milk, and by soda and molasses.

By weight and by volume, 1 part of soda requires 2.2 parts of cream of tartar to free all the gas from it. Therefore, if we make baking powder we use 1 t soda and 2.2 t cream of tartar, which makes 3.2 t baking powder. This, however, is without the filler or starch, which is put in to separate the particles of soda and cream of tartar and to prevent the reaction which follows the absorption of moisture from the air. In tartrate baking powders, on an average, 20% of starch is used; therefore this 3.2 t is 4/5 of the volume of a commercial baking powder containing 20% of filler. Therefore, to make it like the purchased baking powder, there is added .8 of a teaspoon of starch, which brings the total amount of baking powder made with 1 t soda to 4 teaspoons.

Write the proportion needed to make 1 c of tartrate baking powder.

When we use soda with sour milk we substitute for the cream of tartar in baking powder the acid in the milk. Since the gas all comes from the soda in any case, then 1 t soda with the acid from ?, *c* (cf. *Experiment 115*), of sour milk gives off as much gas as 4 t baking powder, because the amount of soda in 4 t baking powder is 1 t. Then 1 t soda from which the gas is freed by sour milk or molasses will give off as much gas as 4 t baking powder.

PROBLEM I. GRIDDLE CAKES

1 c liquid 2 t baking powder

1. Change this to use the same quantity of sour milk as sweet milk.

2. How much soda will be needed? Will this furnish sufficient gas?

PROBLEM II. MUFFINS

1 c liquid 4 t baking powder

3. Change this to use 1 c sour milk.

4. How much soda will be needed?

If the amount of soda used with the sour milk is not equal to 1/4 the amount of baking powder called for, then baking powder may be added to make up the difference in amount of gas. For instance, to prepare fritters, 1/2 t soda might be used, which would give off as much gas as 2 t baking powder. No more soda could be used without its tasting. Therefore 1 t baking powder must be added to furnish the required gas.

Experiment 116. To prepare muffins.

Directions. In groups, prepare muffins using different amounts of fat.

Proportions:

	Liquid	*Flour*	*Fat*	*Eggs*	*Sugar*	*Leavening Agt.*	*Salt*
a.	1 c	2 c	1 T	1	1 T	4 t	½ t
b.	1 c	2 c	2 T	1	2 T	4 t	½ t
c.	1 c	2 c	3 T	1	3 T	4 t	½ t

1. Consider the difference in consistency between muffins and griddle cakes. How should the baking powder be put in?
2. What is the effect on the lightness, of beating after the baking powder is put in?

d. Prepare sour milk muffins.

e. In groups:

1. Prepare graham muffins using half white and half graham flour.
2. Prepare entire wheat muffins using only entire wheat flour.
3. Prepare cornmeal muffins using 1⅓ c white flour and ⅔ c cornmeal.

REFERENCE. "Cornmeal as a Food and Ways of Using It," Farmers' Bulletin 565, 1914.

Mixing. Does the thickness of this batter require any different method of mixing than that for griddle cakes?

Baking. A temperature of 220° C. or 428° F.

Experiment 117. To prepare gingerbread.

Directions.—Proportions:

a. SOUR MILK GINGERBREAD

1 c sour milk	½ t soda for sour milk
2½ c flour	½ t soda for molasses
¼ c fat	1½ t baking powder
1 egg	½ t salt
1 c molasses	1 t cinnamon
½ c sugar	2 t ginger

b. WATER GINGERBREAD

½ c water	¼ t soda
1¼ c flour	¼ t salt
¼ c fat	1 t ginger
½ c molasses	¼ t cloves
¼ c sugar	¼ t cinnamon

2 t baking powder

The egg may be omitted if desired.

Mixing. These are thin batters; if the molasses is not thick and stiff, what method may be used in putting material together?

Baking. Use a temperature of 195° C. or 383° F.

NOTE. In both *a* and *b* the amount of soda used for sour milk and molasses may vary from amounts given here. What other ingredients will this affect? In *b* ¾ t soda may be used in place of adding some baking powder. This is more than would be neutralized by the molasses, but the taste is covered by the spices.

Experiment 118. To prepare Boston brown bread.
Proportions:

Milk	*Flour*	*Sugar*	*Leavening Agt.*	*Salt*	*Raisins*
2 c sour milk	3½ c (graham)	1 c molasses	How much soda?	1 t	1½ c

Directions. Steam in three 1-lb. baking powder cans for 2 hours, then remove covers and dry in a hot oven for 15 minutes.

Baking. The mixture may be baked in a pudding steamer, or any tight covered vessel which does not allow moisture to escape. This process requires about 1 hour.

Change this recipe to use sweet milk.

Experiment 119. To prepare baking powder biscuits.
Proportions:

Liquid	*Flour*	*Sugar*	*Fat*	*Leavening Agt.*	*Salt*
1 c	2⅔ c	1–4 T	3 T	5 t baking powder	1 t

For a soft dough such as baking powder biscuits, the amount of baking powder needed to the excess cup of flour is only 3 instead of 4 teaspoons. This is due to the fact that as the batter is thickened the gas escapes less readily before it is cooked.

Methods of Mixing. a. Work the cold fat into the dry material with a fork or with spatulas. When it has become thoroughly mixed, add the liquid, stirring it in with a knife or fork. A spoon packs it too much. The dough should be

too sticky to take up with the hands. It should be turned out on a lightly floured board and just enough flour sprinkled over the top to make it possible to pat it. The dough may be made from ½ inch to an inch in thickness before it is cut. Put on a tin which has been lightly floured and the flour shaken off. Let stand 15 min.

b. Mix the dry and wet ingredients as in muffins. Compare texture of *a* and *b* and time required to mix.

Baking. Use a very hot oven, so that 12 to 15 minutes will be sufficient time.

Write a recipe for sour milk biscuit.

Experiment 120. To prepare meat pie.

Prepare a cheap cut of meat for meat pie. Cover with gravy and place on top a biscuit crust. Bake it until the crust is done.

Experiment 121. To prepare shortcake.

A shortcake differs from biscuit dough in having more fat and sugar. Owing to the large amount of fat used, water may be substituted for milk.

Proportions:

Liquid	*Flour*	*Fat*	*Sugar*	*Leavening Agt.*	*Salt*
1 c	2⅔ c	5–8 T	3–6 T	5 t	1 t

The shortcake may be rolled to half the thickness of biscuits and baked two layers together. Melted butter may be rubbed on the top of the first layer to make it separate easily from the other. Bake as biscuits. Sliced oranges, peaches, or strawberries may be used for the filling.

Experiment 122. To prepare Dutch apple cake.

Directions. To the biscuit dough made with 1 c liquid, add 1 egg and 2 T sugar. Spread it in a pan, having the dough about an inch thick, and place slices of apples in

rows on the top. Sprinkle with sugar and cinnamon, and bake. Dutch apple cake may be served with a lemon sauce or with cream.

LEMON SAUCE

½ c water	¾ T lemon juice
¾ T flour	4 T sugar
sp. nutmeg	sp. salt

When should the lemon juice be added?

Experiment 123. To prepare doughnuts.

Proportions:

Liquid	*Flour*	*Fat*	*Sugar*	*Eggs*	*Leavening Agt.*	*Salt*	*Spices*
1 c	4 c	1 T	1 c	2	4 t B. P.	2 t	¼ t cinnamon, ⅛ t nutmeg

Mixing. Mix sugar and fat and eggs together, then milk and dry materials. Roll the dough out on a floured board until it is about ½ inch thick. Cut.

Fry in deep fat. What temperature would you use? Change this recipe to use sour milk instead of sweet.

Experiment 124. To prepare pastry.

Directions.—Proportions:

Liquid	*Flour*	*Fat*	*Salt*
½ T	1 c	¼-⅓ c	¼ t

The amount of water added will depend upon the amount of fat used; the greater the amount of fat, the smaller the amount of water.

Mixing. Mix the cold fat into the flour with a knife or fork. Experienced housekeepers frequently mix the fat into the flour with the finger-tips. This, however, is more likely to make a tough crust, owing to the fact that the heat

of the hands makes the fat softer and consequently makes it necessary to put in more flour. Add cold water as in baking powder biscuit.

Baking. When the filling is in the form of a liquid or a juicy fruit, bake the under crust slightly before filling, to prevent sogginess. In order to make the top crust stick to the lower, moisten the rim a little. A granite pie pan has been found to give most satisfactory results in baking juicy pies; old tin ones next; and, lastly, wire or perforated ones.

How do eggs in the filling of a pie affect the temperature to be used in the baking?

Roll out the crust on a slightly floured board.

Make a table of the cost of pie crust made from 1 c flour, using different fats.

FILLINGS

1. *Custard Filling.* Write a recipe for a custard filling on the basis of 1½ c milk. This will be sufficient for a large pie. This is to be put in the pie and baked.

2. *Chocolate Filling.*

1 c milk	2 yolks eggs, or
2½ T flour	1 whole egg
½ c sugar	$\frac{1}{16}$ t salt
½ square chocolate	

Whites of eggs may be used as a meringue. Give directions for making this filling.

3. *Lemon Filling.*

1 c water	2 egg yolks
1 c sugar	4 T lemon juice
6 T flour	(1 lemon)

How would you mix and cook this in order to lose none of the thickening power of the flour and eggs and yet have

the starch well cooked? If cornstarch is used in place of flour, how much will be needed?

4. *Fruit Pies.* Fillings made with juicy fruits need no water added; others do. Both kinds are improved by the addition of a little flour to thicken the juice. Lemon juice may be added to give tartness.

CHAPTER XXIV

BREAD

Bring samples of both home-made and baker's bread to class. To determine how these samples rank examine them for the following conditions. This is a score card used in judging bread contests in Women's Institutes:

	Points
Thoroughness of baking	20
Color: (1) Shade, golden brown	6
(2) Evenness	6
Shape of loaves, oblong; 1 to 2 lbs	8
Sweetness, no sourness after thorough mastication	25
Flavor, slightly nutty	15
Quality of crumb, moist but not wet	8
Evenness of crumb	3
Fineness of crumb	4
Color of crumb, cream rather than pearl white	5
Total,	100

REFERENCE. Experiment Station Bulletin 225.

Let us take the points to be considered in the order of the numerical values given them, and consider what controls them.

1. *Sweetness.* The factors affecting it are:

a. The number of yeast plants, their variety, and freedom from contamination by bacteria or other organisms producing acids. Compressed yeast should

show no dark spots on its surface nor give the slightest sour odor. This must be carefully distinguished from a true yeast odor. Dry yeast cakes several weeks old form gas very slowly.

b. Temperature of the dough when it is set away to rise.

c. Thoroughness of baking.

2. *Thoroughness of baking.*
   a. Size of loaf.
   b. Temperature of oven.
   c. Time allowed to bake.
3. *Flavor.* Due chiefly to:
   a. Flour, which should have a sweet, nutty odor.
   b. Amounts of salt and of sugar.
4. *Color of loaves.*
   a. Temperature of the oven.
   b. Time in the oven.
   c. Position in the oven.
5. *Shape of loaves.*
   a. Shape of pan. Use oblong narrow pan. Bake one loaf in one pan.
   b. Position in oven.
6. *Quality of crumb.*
   a. Proportion of flour to liquid.
7. *Color of crumb.*
   a. Color of flour.
8. *Fineness and evenness.*
   a. Thoroughness of kneading.
   b. Time allowed to rise.

If a good yeast is selected the other condition which controls sweetness is temperature.

Experiment 125. To determine the best temperature for yeast growth.

Directions. Into ½ c water put ½ t sugar and $\frac{1}{16}$ yeast cake. Fill 4 test tubes with this mixture. Invert. This is

most easily done by putting a small piece of paper over the top and inverting a small cup on it. Have some water ready and pour into the bottom of cup as soon as the angle will permit.

Note. Fermentation tubes are more convenient than test tubes for this purpose, but they are fragile and cost about 30 cents each.

a. Freeze one.

b. Place one at room temperature.

c. Place one in the refrigerator or out of doors where it will not freeze.

d. Place one at a temperature of 90° F. (This may be done by using the sun or radiator or other artificial heat.)

e. Heat some of the mixture to 129° F. or 54° C. Fill a test tube and invert as before.

Notice the amount of gas formed at the end of an hour in each case. At the end of this time, bring those that were in the cold, into room temperature. Notice them at the end of another hour.

Conclusions. 1. What temperature allows the most rapid growth of yeast?

2. What is the effect of freezing on the yeast plants?

3. What is the death temperature of yeast plants?

4. If bread is sufficiently light, and there is no opportunity to bake it, what could be done?

5. At what temperature should compressed yeast be kept?

6. Would freezing spoil it?

Note. 143° F. is necessary to kill yeast spores.

Experiment 126. To show the difference in the rate of gas formation between dried and compressed yeast.

Use $\frac{1}{16}$ cake of dried yeast and the same quantity of compressed yeast. Mix each with water and sugar as in

previous experiment. Invert tubes of each and note the rate of the gas formation.

Some of the yeast plants in the dried yeast cake have been killed, and others require some time to revive.

Experiment 127. To prepare bread.

Proportions:

Liquid	*Flour*	*Fat*	*Sugar*	*Leavening Agt.*	*Salt*
1½ c	4½ c	1½ T	0-1½ T	Yeast	1½ t

This amount will make a little over a pound loaf of bread.

The liquid may be all milk, all water, or half milk and half water, or potato water. Excellent bread may be obtained with the use of all water.

A whole cake of compressed yeast will finish baking the bread in about 8 hours. If longer time is to be taken, as in setting it the night before, use less proportionately; if a shorter time, use more.

MIXING, SHORT PROCESS

a. Temperature of liquids. In order to decrease the chances of having sour bread, when milk is used it is first heated to the scalding point, to kill most of the lactic acid bacteria. When water is used, there are fewer possibilities of acid producing bacteria, consequently not so high a temperature is needed for this. It may be heated to body temperature and the fat melted in it. At this temperature the liquid feels neither hot nor cold to the finger. The compressed yeast should be put to soak in about ¼ c of the lukewarm liquid. If it is much more than lukewarm it will make a pasty mass which rises very slowly. It is thought that a higher temperature kills enzymes in the flour. The enzymes turn starch to sugar and also give flavor.

b. Temperature of flour. If flour is stored in a cold place it should be allowed to stand at room temperature until it is warmed before it is made into dough.

c. Making of the dough.

1. By hand. Put all the material except the soaking yeast and half the flour together, and beat them into a smooth, soft dough. Now add the yeast and the remaining flour, or enough flour to make the dough *feel sticky but not really stick to the hands.*
2. By bread mixer. When mechanical mixing is used, the materials may all be put in at once, care being taken about the temperature of the liquid.

d. Kneading.

1. By hand, until there are no lumps.
2. By mixer, for five minutes.

   The purpose of kneading is to get the material thoroughly mixed and to fold in air all through the dough. This is necessary for the growth of the yeast plant.

e. Rising. The dough may be placed:

1. Near but not touching a radiator or register.
2. On several thicknesses of paper or board on top of a radiator.
3. In a slightly warmed oven under which there is no fire.
4. In the sun.
5. In a fireless cooker.

NOTE. In order to prevent the evaporation of water from the dough while it is rising, and the consequent formation of a crust, a coating of fat should be brushed over the top, or a tight cover used.

f. Amount of rising. Let the dough rise until it rebounds when touched lightly on top. At this stage it is about twice its former bulk.

g. Second kneading. This is done to make a fine grain.

All large bubbles should disappear, and when the dough is kneaded only a fine, even grain should be seen. It may now be moulded into loaves and allowed to rise again.

h. Second rising. The same test for lightness may be used. When it answers to this it is ready to bake.

Mixing, Long Method

When dried yeast is used, a sponge should be made first. This differs from the short process in having about half the flour left out before the first rising. When this sponge has become light, as shown by the large number of bubbles on the surface, the remainder of the flour is added and the process is the same as with the short method.

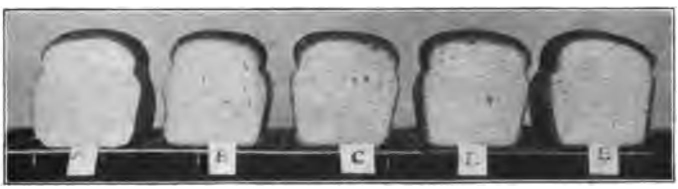


Plate 24.—Effect of Sugar. (Courtesy of the University of Illinois.)

Loaf	A	B	C	D	E
Teaspoonfuls Sugar	0	2	4	6	8

As each teaspoonful of sugar above 1 to a loaf is used, a slight increase in volume is given. How does an increase of salt affect the volume? See plate 25.

i. Baking. Bread is more thoroughly baked when the loaves are baked singly and are of not more than 2 lbs. in weight. The center of a large loaf is often under-done and sour when the outer part is of the proper color and moisture. In baking, use from 195° C. to 210° C. for from 45 to 60 minutes.

Test. Bread is done when tapping on both bottom and top produces a hollow sound.

The products formed by the growth of yeast are evaporated in baking so that no alcohol is left in the bread. The odors of baking bread are due partly to this and partly to the changes in carbohydrates and fats.

j. Care after baking. The general opinion is that the crust should be crisp rather than soft. Allowing the bread to cool in the free air after baking, before putting it away, keeps a crisp crust.

ROLLS

These vary in elaborateness from currant cinnamon rolls to plain bread biscuits. They may have more fat and sugar than bread has, as well as egg and flavoring, which bread

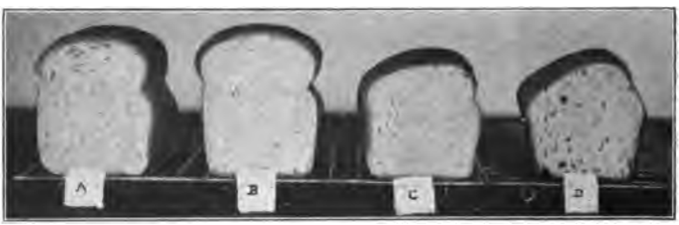


Plate 25.—Effect of Salt.

Loaf	A	B	C	D
Teaspoonfuls Salt	0	1	2	3

has not. Sometimes the only variation is in shape. They are all allowed to become much lighter than bread dough before baking, and they are baked at 225° C. from 12 to 15 minutes.

1. *Parkerhouse.* Use bread proportion, except change to 2 T of fat and 2 T of sugar. Roll the dough to ½ inch thickness, shape with biscuit cutter, spread the surface with melted butter, make a crease lightly in the centre of each circle with a spatula or common knife, and fold one half over the other, pressing the edges together. Place close

together on a floured or greased pan, so that in rising they grow high rather than spread out. When so light that they seem almost ready to burst they are ready to bake.

2. *Salad or Dinner Rolls.* Use 3 T fat. Braids, clover leaves, twists, etc., are made of such dough.

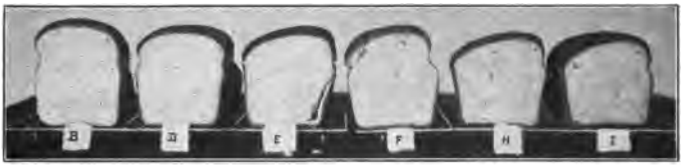


Plate 26.—Effect of Salt and Sugar.

Loaf	B	D	E	F	H	I
Teaspoonfuls Salt	1	1	1	2	2	2
Teaspoonfuls Sugar	0	2	4	0	2	4

D and E require the least time for the breadmaking process.

3. *Swedish or Cinnamon Rolls.* Roll either of the above doughs to 1/4 inch thickness. Sprinkle over it sugar, mixed with a little cinnamon, and currants, chopped raisins, or

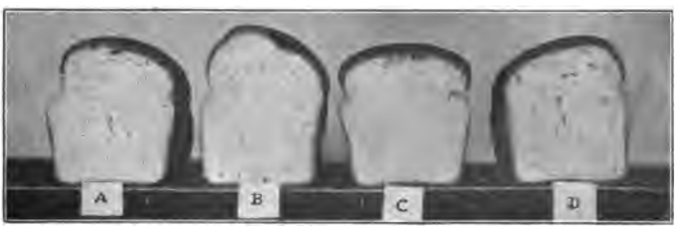


Plate 27.

Loaf	A	B	C	D
Teaspoonfuls Salt	½	2	1	2
Teaspoonfuls Sugar	0	0	2	2

From results shown in plates 24 and 25, which of these loaves would you expect to be smallest?

citron, as desired. Roll the dough as a soldier rolls a blanket and cut into 1-inch pieces. Place flat side down and bake as Parkerhouse rolls. Their surface may be glazed by brushing it over with slightly beaten white of egg plus ½ T water when they are taken from the oven. They should then be returned to oven to dry.

4. *German Coffee Bread.* Make a rich, sweet dough; ⅜ c each of fat and sugar to 1½ c liquid. Add 1 egg and ½ c chopped raisins.

To mould: Spread out the dough ½ inch thick on a greased pan 3 to 4 inches deep. When light and ready to bake, brush the surface with egg and then with melted butter, sugar, and cinnamon. When the sugar is partially melted, shake a little flour over the surface. Bake at roll temperature.

Methods of Using Stale Bread

1. Dry the bread and pulverize it in a meat grinder, to be used for scalloped dishes, breading chops, croquettes, dressing and stuffing for fowls, etc.

2. *Bread Puddings.*

a.	2 c crumbs	2 eggs
	4 c milk	1 t vanilla or
	⅔ c sugar	2 squares chocolate
	¼ t salt	

Bake in a buttered dish in a moderate oven.

Serve with cream, whipped cream flavored with sugar and vanilla, or hard sauce.

HARD SAUCE

1/3 c butter	1/3 t lemon extract
1 c powdered sugar	2/3 t vanilla

Cream the butter, and add the sugar gradually

3. *Brown Betty.*

Bread crumbs Apple sauce
Spice and butter

Arrange the crumbs and sauce in layers. Dot each layer with butter and sprinkle lightly with spice, cinnamon, and nutmeg. Add a little lemon juice. Bake as bread pudding.

Use stale slices as follows:

a. French Toast. Dip the slices in a custard of 1 c milk and 3 eggs, 1/4 t salt. Sauté in butter. Serve with syrup.

b. Buttered slices may be used instead of bread crumbs for Brown Betty.

Digestibility and Nutritive Value of Bread. From a large number of experiments it has been found that a larger percentage of the nutrients of white bread are digested than of entire bread or graham. On this score, then, those breads have not superior value. They do, however, contain more ash and in cases of constipation may be useful. Their flavors may also recommend them for variety, but these flours are more expensive than white flour.

The digestibility of bread depends largely upon its lightness and dryness. The softness and tendency of new bread to form pasty balls is the reason for its indigestibility. Thorough mastication of all

foods is most important. Toast is easy of digestion because of its crispness, which insures thorough mastication, and change of the outer starch to dextrin. Breads deserve their name "staff of life" on account of their thoroughness of digestion, cheapness, and mildness of flavor, which makes them easy to combine with other foods.

REFERENCES. "Bread and Bread Making," Farmers' Bulletin 389, 1910. "Studies on Bread and Bread Making at the University of Minnesota," Bulletin 101, Office of Experiment Stations. "Bread and Toast," Experiment Station Work XXV, Farmers' Bulletin 193, pp. 26-29. "Some Points in the Making and Judging of Bread," by Isabel Bevier, Household Science Dept. Bulletin, University of Illinois.

CHAPTER XXV

CAKE AND COOKIES

Cook books are full of recipes for cake. One recipe differs from another often in the amount of material used, consequently in the size of the cake made, or by a slight variation in the amount of a single ingredient. It will simplify cake making to get a table showing what variations may be made in the amount of different ingredients, and still have a good cake.

Cake differs from muffins in containing more sugar, fat and flavoring, and sometimes more eggs.

Experiment 128. To prepare cottage pudding.

Proportions:

Liquid	*Flour*	*Fat*	*Sugar*	*Egg*	*Baking Powder*	*Salt*	*Flavoring*
1 c	2¼ c	¼-⅓ c	⅔ c	1	4 t	½ t	½ t

How do these proportions vary from those in muffins? Compare with cake in *Exp. 129.*

Serve with lemon or chocolate sauce.

Experiment 129. To prepare cake.

Proportions: The following proportions make a moderately rich cake:

Liquid	*Flour*	*Fat*	*Sugar*	*Baking Powder*	*Salt*	*Flavoring*	*Eggs*
1 c	3 c pastry 2⅝ c bread	½ c	1½ c	3 t	½ t	1 t	1–4

The fat may be varied down to 1/4 c or increased to 2/3 c, with an increase of 2 t baking powder with the latter. The more eggs used, the more compact the cake is; for instance, one egg makes a very flaky cake. Two whites may be substituted for a yolk. Where the fat is over a half cup, the lightness is increased by beating the whites until stiff and folding them in. Two yolks may be substituted for one whole egg, thus making a gold cake. Chocolate (2 squares) and spices (1 t cinnamon, 1/2 t cloves, and 1/4 t nutmeg) may be added. When chocolate is used, another teaspoon of baking powder is needed.

Other fats may be substituted for butter. When a large quantity of fat is required—for example, 2/3 c or more—use 1/8 less than the amount of butter given; Because butter contains about 12 1/2% water, while cottolene, snow drift, etc., contain no water. If other fats than butter are used, an increase of 1/2 the amount of salt and flavoring is needed to hide the taste of these other fats and to make up for the salt in butter.

Methods of Mixing. There is more than one way of getting the fat mixed with other ingredients:

1. Creaming of the hard fat and sugar together.
2. Creaming of the softened fat and sugar together.
3. Putting all materials together and then mixing thoroughly. When the whole egg is used, it may be added without beating. What would be the effect of beating after the cake is thoroughly mixed?
4. A cake mixer similar to a bread mixer may be used with the third method, providing there is enough batter to at least half fill the mixer; otherwise the mixer gives poor results.

Baking. The best temperature for baking is from 195° C. to 210° C., or 360° F. to 410° F.

In groups of three, use the three methods mentioned

above of mixing a cake, when preparing No. 1 of the following:

1. A cake with whole egg.

Prepare one of the following:

1. A white cake.
2. A gold cake.
3. A chocolate cake.
4. A spice cake.
5. A nut cake.
6. A currant cake.

Score Card for Judging Cake

Flavor	30	Moderate, not strong
Lightness	20	
Texture	20	Fine and even. Tender and more flaky than bread
Baking	20	Level, symmetrical, a golden brown
Appearance (icing)	10	Smooth on surface and in texture
Total,	100	

Uses for Stale Cake

1. Steam and serve with a pudding sauce.
2. Dry thoroughly and crumb. Add to a custard to help thicken it.

Proportions:

2 c milk	½–1 c cake crumbs
2 yolks	½–1 T gelatin
⅓ c sugar	

Almond and mapleine flavoring. Serve with cream.

Frostings

BOILED FROSTING

1 c sugar	1–2 egg whites
⅓ c water	¾ t vanilla

Boil sugar and water together until the syrup makes a thread when it drops from a spoon. This should be about 2 inches long for two whites, and a little shorter for one. Pour this on the stiffly beaten white, stirring continually to prevent coagulation.

A small piece of citric acid dissolved in ½ t water and added to the frosting when it is beginning to thicken takes away the deadly sweetness.

For chocolate frosting, add to the mixture of syrup and egg whites 1½ squares of melted chocolate.

CHOCOLATE ICING

½ egg	1½ c powdered sugar
3 T cream	1 sq melted cholocate

Melt chocolate, add to powdered sugar mixed with egg and cream.

WHITE OF EGG FROSTING, UNCOOKED

White of 1 egg	½ t vanilla or ½ T lemon juice
¾ c powdered sugar	2 t cold water

Beat white of egg until stiff; add the water and sugar Beat until smooth, then add the flavoring. It may be necessary to add a little more sugar if the egg is very large.

Cookies

Rolled cookies vary from cake mainly in the large quantity of flour and sugar used in proportion to the liquid.

Experiment 130. To prepare cookies of varying richness.

Proportions:

Liquid and Fat	*Flour*	*Sugar*	*Eggs*	*Leavening Agent*	*Salt*	*Flavoring*
1/4 c	1 c	8 T	1/2–1	1 t B. P.	1/2 t	1 t vanilla
						1/2 t lemon
						1/2 t cinnamon
						1/4 t cloves
						1/8 t nutmeg
						1 sq chocolate

In considering cookies which are to be rolled, the amount of flour depends upon the amount of wet material, namely, fat, liquid, and egg. Of this 1/4 c liquid, 1 T may be water and the rest fat, or, if a less rich cooky is desired, equal quantities of water and fat may be used.

Cookies are mixed like cake, then rolled out, cut, and baked. They should be baked on oiled tins at a moderate temperature. Cookies with molasses are best mixed by heating the wet materials together until the fat is melted. They should then be chilled before rolling, so that no extra flour will have to be added.

Experiment 131. To prepare cookies containing molasses.

MOLASSES ROLLED COOKIES

Liquid	*Flour*	*Sugar*	*Egg*	*Leavening Agent*	*Spices*	*Salt*
1/4 c milk and fat (1 T milk; 3 T fat)	2 c	1/2 c molasses 1/4 c sugar	1	3/8 t soda	1 t cinnamon 1/2 t cloves 1/4 t nutmeg 1/8 t ginger	1/2 t

GINGER SNAPS

Liquid	*Flour*	*Sugar*	*Leavening Agent*	*Salt*	*Ginger*
1/4 c milk and fat (1 T milk; 3 T fat)	1 c	1/3 c molasses	1/4 t soda	1/2 t	1 t

CHAPTER XXVI

THE PREPARATION OF MEALS

So far foodstuffs have been studied by themselves or in combination as one preparation. Now the problem is to make selections for a meal or for a day's meals to give the body the proper quantity and right kinds of nutrients.

It is impossible to determine definitely the amount of food to be eaten. Many conditions enter into the consideration of it. Overeating is usually accompanied by digestive disturbances, however, and a steady increase in weight. Calories in excess of the body's requirements, whether of carbohydrate or fat, lead to the storage of fat in the body. The following tables have been compiled by insurance companies as an average from many thousands of people. From these we may judge whether an increase in weight is desirable or not, and to what extent.

TABLE OF HEIGHT AND WEIGHT FOR MEN AT DIFFERENT AGES

Based on 74,162 Accepted Applicants for Life Insurance

Ages	15–24	25–9	30–4	35–9	40–4	45–9	50–4	55–9	60–4	65–9
5 ft. 0 in.	120	125	128	131	133	134	134	134	131	
1 in.	122	126	129	131	134	136	136	136	134	
2 in.	124	128	131	133	136	138	138	138	137	
3 in.	127	131	134	136	139	141	141	141	140	140
4 in.	131	135	138	140	143	144	145	145	144	143

TABLE OF HEIGHT AND WEIGHT FOR MEN AT DIFFERENT AGES
(Continued)

Based on 74,162 Accepted Applicants for Life Insurance

Ages	15–24	25–9	30–4	35–9	40–4	45–9	50–4	55–9	60–4	65–9
5 ft. 5 in.	134	138	141	143	146	147	149	149	148	147
6 in.	138	142	145	147	150	151	153	153	153	151
7 in.	142	147	150	152	155	156	158	158	158	156
8 in.	146	151	154	157	160	161	163	163	163	162
9 in.	150	155	159	162	165	166	167	168	168	168
10 in.	154	159	164	167	170	171	172	173	174	174
11 in.	159	164	169	173	175	177	177	178	180	180
6 ft. 0 in.	165	170	175	179	180	183	182	183	185	185
1 in.	170	177	181	185	186	189	188	189	189	189
2 in.	176	184	188	192	194	196	194	194	192	192
3 in.	181	190	195	200	203	204	201	198		

From *Chemistry of Food and Nutrition,* by Sherman, page 216.

TABLE OF HEIGHT AND WEIGHT FOR WOMEN AT DIFFERENT AGES

Based on 58,855 Accepted Applicants for Life Insurance.

Ages	15–9	20–4	25–9	30–4	35–9	40–4	45–9	50–4	55–9	60–4
4 ft. 11 in.	111	113	115	117	119	122	125	128	128	126
5 ft. 0 in.	113	114	117	119	122	125	128	130	131	129
1 in.	115	116	118	121	124	128	131	133	134	132
2 in.	117	118	120	123	127	132	134	137	137	136
3 in.	120	122	124	127	131	135	138	141	141	140
4 in.	123	125	127	130	134	138	142	145	145	144
5 in.	125	128	131	135	139	143	147	149	149	148
6 in.	128	132	135	137	143	146	151	153	153	152
7 in.	132	135	139	143	147	150	154	157	156	155
8 in.	136	140	147	151	155	158	161	161	161	160
9 in.	140	144	147	151	155	159	163	166	166	165
10 in.	144	147	151	155	159	163	167	170	170	169

From *Chemistry of Food and Nutrition.*

The amount of food material needed for each person is influenced by several things.

1. **Muscular Activity.** From many experiments with vigorous young men the effect of muscular activity on the number of calories used may be seen.

Man sleeping	65	calories	per	hour
Man sitting at rest	100	"	"	"
Man at light muscular exercise (going to and from work)	170	"	"	"
Man at active muscular exercise	290	"	"	"
Man at severe muscular exercise	450	"	"	"
Man at very severe muscular exercise	600	"	"	"

This table shows the decided influence of muscular activity upon the amount of fuel required. Almost ten times as much fuel is required with very severe muscular work such as that of a lumberman as for a man asleep; less than one-third as much for a professional man doing light muscular work as for a lumberman.

2. **Size and Shape.** The greater the surface exposed, in proportion to the weight, the greater the number of calories needed. A thin, muscular man of 156 pounds used 15 calories per pound. Under the same conditions, a shorter, stout man of 162 pounds used 13 calories per pound. This is explained by the fact that it is only living cells which burn fuel. The stout man's fat is lifeless material. It is fuel which makes heat and is useful when burned by the living cells. In addition to this, the greater

surface of the thin man in proportion to his weight gives more chance for cooling the body; therefore, more calories are needed to keep it warm. Ordinarily the shape of the body is not taken into consideration.

3. Age and Sex. Muscular activity in children is intense, not in the sense that they are working as we think of work ordinarily, but that their muscles are usually in motion while they are awake. A muscle uses fuel at all times except when it is relaxed as in quiet, sound sleep. To hold the body, or any of its parts, in anything but a limp condition, requires fuel for the muscles.

The following table illustrates the decrease in the number of calories according to age. In no case is any muscular labor done.

Age, years	*Height, Ft.–In.*	*Weight, Lbs.*	*Total Calories per Day*	*Total Calories per Pound*
1	2.3	22	1,000	45.5
5	3.3	37	1,400	37.3
10	4.2	57	1,800	32
15	...	110	2,800	25.5
20	5.7	143	3,000	21
30	5.8	152	2,750	18
40	5.7	154	2,500	16.3
60	...	143	2,200	15.5
80	...	132	1,600	12.2

From Sherman's *Chemistry of Food and Nutrition*, p. 174.

Since the weight of individuals differs greatly, the following tables may be used as a guide in calculating the number of calories:

Under one year	45.5 calories per pound
1– 2 years	45.5–41 calories per pound
2– 5 years	41 –36.3 calories per pound
6– 9 years	36.3–32 calories per pound
10–13 years	32 –27.2 calories per pound
14–17 years	27.2–20.4 calories per pound

For young to middle-aged men and women, a German scientist, Von Noorden, allows:

At complete rest	14.6–15.9 calories per pound
With light exercise	15.9–18.2 calories per pound
With moderate exercise	18.2–20.4 calories per pound
With hard muscular work	20.4–27.2 calories per pound

From Sherman's *Chemistry of Food and Nutrition.*

The amount of protein used by a man at rest and one doing vigorous work is practically the same. When a muscle works, it uses up fuel, not building material. There is constantly in health a very slight breaking down of cells which a small amount of protein will be sufficient to repair. To increase in size as muscles do with prolonged hard work requires protein. This, however, will be taken care of if one-tenth of the calories is furnished by protein.

The question of protein in the diet is a much disputed point. In all probability, Americans eat too much of it. The high prices of meat in later years have done something to cut down the amount of protein from that source. Other cheaper sources of

protein are used much more than they used to be: cheese, macaroni, beans, and eggs. On account of the lack of flavor in these there is not so great a tendency to give them as large a place in the diet as meat is given. It has been thought for some time that protein from the vegetable kingdom was not so well used by the body as animal protein. The difference seems to be due to a great extent to its being so entangled with cellulose that the digestive juices cannot get at it. This may be largely remedied by proper cooking, as has been mentioned in the case of beans.

The amount of protein to be entirely sufficient is probably between sixty and seventy-five grams per day for the average adult. From 100 to 150 grams have been thought necessary, but there seems to be a general opinion in favor of the smaller quantity. As the muscular activity increases, the appetite increases likewise, but the additional food should be made up largely by carbohydrate. In case of recovery from a wasting disease, it is wise to increase the proportion of protein so that new tissue may be formed. Persons using this lower quantity of protein, after many years of experience, find that they are much freer from fatigue, headache, and minor ailments than under a diet containing more protein. Chittenden, of Yale, is the best known advocate of this lower protein diet. All changes in quantity and kind of diet must, however, be made gradually.

One reason for the better health from the low protein diet may be the kind of ash present in protein. The ash from protein, that is, from meat, eggs, and cereals, must be neutralized by the ash from fruit, vegetables, or milk in order to keep the body in proper condition. Therefore, protein foods must not be given a place in the diet to the exclusion of fruits and vegetables. Recall what was said about the cooking of vegetables with regard to retaining their ash. Pure carbohydrates, as sugar and starch, butter and other fats, do not contain ash, therefore they cannot be substituted for these vegetable foods.

Fat should not furnish more than half as many calories in the diet as the carbohydrates.

In calculating the number of calories in the total amount of food and the number supplied by the different nutrients Fisher's 100-calorie portion table is invaluable.

NOTE TO THE TEACHER. Have an exhibit of 100 calorie portions of foods commonly used. Measure cereals, milk, and cream in a measuring cup. Count the number of pieces of dried and fresh cooked fruit. Take dimensions of slices of bread and cake and meat.

When the pupils have seen these portions, have them keep a record of their own diets for about three ordinary days and calculate how this compares with their needs according to the tables in this chapter.

TABLE OF 100 FOOD UNITS

COOKED MEATS

Name of Food	"Portion" Containing 100 Food Units (approx.)	Wt. of 100 Calories		Per cent of		
		Grams	Oz.	Protein	Fat	Carbo-hydrate
†Beef, r'n'd, boiled (fat) 1099‡	Small serving	36	1.8	40	60	00
†Beef, r'd, boiled (lean) 1206‡	Large serving	62	2.2	90	10	00
†Beef, r'd, boiled (med.) 1188‡	Small serving	44	1.6	60	40	00
†Beef, 5th rib, roasted, 1538‡	Half serving	18.5	.65	12	88	00
†Beef, 5th rib, roasted, 1616‡	Small serving	32	1.2	25	75	00
†Beef, 5th rib, roasted, 1615‡	Very small s'v'g.	25	.88	18	82	00
‡Beef, ribs boiled, 1169‡	Small serving	30	1.1	27	73	00
†Beef, ribs boiled, 1170‡	Very small s'v'g.	25	.87	21	79	00
*Calves foot jelly		112	4.	19	00	81
*Chicken, canned	One thin slice	27	.96	23	77	00
*Lamb chops, boiled, av	One small chop	27	.96	24	76	00
*Lamb, leg, roasted	Ord. serving	50	1.8	40	60	00
†Mutton, leg, boiled, 1184‡	Large serving	34	1.2	35	65	00
†Pork, ham, boiled (fat) 1174‡	Small serving	20.5	.73	14	86	00
†Pork, ham, boiled, 1192‡	Ord. serving	32.5	1.1	28	72	00
†Pork, ham, r'st'd (fat) 1484‡	Small serving	27	.96	19	81	00
†Pork, ham, r'st'd (lean) 1511‡	Small serving	34	1.2	33	67	00
*Turkey, as pur., canned	Small serving	28	.99	23	77	00
†Veal, leg, boiled, 1182‡	Large serving	67.5	2.4	73	27	00

UNCOOKED MEATS, EDIBLE PORTION

Name of Food	"Portion" Containing 100 Food Units (approx.)	Grams	Oz.	Protein	Fat	Carbo-hydrate
*Beef, loin, av. (lean)	Ord. serving	50	1.8	40	60	00
*Beef, loin, av. (fat)	Small serving	30	1.1	22	78	00
*Beef, loin, p'house steak, av	Small steak	36	1.3	32	68	00
*Beef, loin, sirloin steak, av	Small steak	40	1.4	31	69	00
*Beef, ribs, lean, av	Ord. serving	52	1.8	42	58	00
*Beef, round, lean, av	Ord. serving	63	2.2	54	46	00
*Beef, tongue, average	Ord. serving	62	2.2	47	53	00
*Beef, juice		395	14.	78	22	00
*Chicken (broilers), av	Large serving	90	3.2	79	21	00
*Clams, r'nd in shell, av	Twelve to 16	210	7.4	56	8	36
*Cod, whole	Two servings	138	4.9	95	5	00
*Goose (young), av	Half serving	25	.88	16	84	00
*Halibut steaks, av	Ord. serving	81	2.8	61	39	00
*Liver (veal), av	Two small s'v'g.	79	2.8	61	39	00
*Lobster, whole, av	Two servings	117	4.1	78	20	2
*Mackerel (Spanish), whole, av	Ord. serving	57	2.	50	50	00
*Mutton leg, hind, lean, av	Ord. serving	50	1.8	41	59	00
*Oysters, in shell, av	One dozen	193	6.8	49	22	29
*Pork, loin chops, av	Very small s'v'g.	27	.97	18	82	00
*Pork, ham, lean, av	Small serving	36	1.3	29	71	00
*Pork, bacon, med. fat, av	Small serving	15	.53	6	94	00
*Salmon (California), average	Small serving	42	1.5	30	70	00
Shad, whole, average	Ord. serving	60	2.1	46	54	00
*Trout, brook, whole, av	Two small s'v'g.	100	3.6	80	20	00
*Turkey, average	Two small s'v'g.	33	1.2	29	71	00

VEGETABLES

Name of Food	"Portion" Containing 100 Food Units (approx.)	Grams	Oz.	Protein	Fat	Carbo-hydrate
*Artichokes, av. canned		430	15	14	0	86
*Asparagus, av. canned		540	19	33	5	62

*Chemical Composition of American Food Materials, Atwater and Bryant, U. S. Department of Agriculture Bull. No. 28.

†Experiments on Losses in Cooking Meats. (1900-03), Grindley, U. S. Department of Agriculture Bull. No. 141.

‡Laboratory number of specimen, as per Experiments on Losses in Cooking Meat.

By the courtesy of Mr. Irving Fisher.

VEGETABLES—Continued

Name of Food	"Portion" Containing 100 Food Units (approx.)	Wt. of 100 Calories: Grams	Oz.	Per cent of: Protein	Fat	Carbohydrate
*Asparagus, av. cooked		206	7.19	18	63	19
*Beans, baked, canned	Small side dish	75	2.66	21	18	61
*Beans, Lima, canned	Large side dish	126	4.44	21	4	75
*Beans, string, cooked	Five servings	480	16.66	15	48	37
*Beets, edible portion, cooked	Three servings	245	8.7	2	23	75
*Cabbage, edible portion		310	11	20	8	72
*Carrots, edible, portion, fresh		215	7.6	10	8	82
Carrots, cooked	Two servings	164	5.81	10	34	56
*Cauliflower, as purchased		312	11	23	15	62
*Celery, edible portion		540	19	24	5	71
Corn, sweet, cooked	One side dish	99	3.5	13	10	77
*Cucumbers, edible portion		565	20	18	10	72
*Egg plant, edible portion		350	12	17	10	73
Lentils, cooked		89	3.15	27	1	72
*Lettuce, edible portion		505	18	25	14	61
*Mushrooms, as purchased		215	7.6	31	8	61
*Onions, fresh, edible portion		200	7.1	13	5	82
*Onions, cooked	Two large s'v'gs	240	8.4	12	40	48
*Parsnips, edible portion	1½ serving	152	5.3	10	7	83
Parsnips, cooked		163	5.84	10	34	56
*Peas, green, canned	Two servings	178	6.3	25	3	72
*Peas, green, cooked	One serving	85	3	23	27	50
Potatoes, baked	One good sized	86	3.05	11	1	88
*Potatoes, boiled	One large sized	102	3.62	11	1	88
*Potatoes, mashed (creamed)	One serving	89	3.14	10	25	65
Potatoes, steamed	One serving	101	3.57	11	1	88
*Potatoes, chips	One-half serving	17	.6	4	63	33
*Potatoes, sweet, cooked	Half av. potato	49	1.7	6	9	85
*Pumpkins, edible portion		380	13	15	4	81
Radishes, as purchased		480	17	18	3	79
Rhubarb, edible portion		430	15	10	27	63
*Spinach, cooked	Two ord. s'v'g	174	6.1	15	66	19
Squash, edible portion		210	7.4	12	10	78
*Succotash, canned	Ord. serving	100	3.5	15	9	67
*Tomatoes, fresh as purchased	Four av	430	15	15	16	69
Tomatoes, canned		431	15.2	21	7	72
*Turnips, edible portion	Two large s'v'g	246	8.7	13	4	83
Vegetable oysters		273	9.62	10	51	39

FRUITS (DRIED)

Name of Food	"Portion" Containing 100 Food Units (approx.)	Grams	Oz.	Protein	Fat	Carbohydrate
*Apples, as purchased		34	1.2	3	7	90
Apricots, as purchased		35	1.24	7	3	90
*Dates, edible portion	Three large	28	.99	2	7	91
*Dates, as purchased		31	1.1	2	7	91
*Figs, edible portion	One large	31	1.1	5	0	95
*Prunes, edible portion	Three large	32	1.14	3	0	97
*Prunes, as purchased		38	1.35	3	0	97
*Raisins, edible portion		28	1.	3	9	88
*Raisins, as purchased		31	1.1	3	9	88

FRUITS (FRESH OR COOKED)

Name of Food	"Portion" Containing 100 Food Units (approx.)	Grams	Oz.	Protein	Fat	Carbohydrate
*Apples, as purchased	Two apples	206	7.3	3	7	90
Apples, baked		94	3.3	2	5	93
Apples, sauce	Ord. serving	111	3.9	2	5	93
*Apricots, edible portion		168	5.92	8	0	92
Apricots, cooked	Large serving	131	4.61	6	0	94
*Bananas, edible portion	One large	100	3.5	5	5	90
*Blackberries		170	5.9	9	16	75
Blueberries		128	4.6	2	8	90

FRUITS (FRESH OR COOKED)—Continued

Name of Food	"Portion" Containing 100 Food Units (approx.)	Wt. of 100 Calories Grams	Oz.	Per cent of Protein	Fat	Carbohydrate
*Blueberries, canned		165	5.8	4	9	87
Cantaloupe	Half or. serving	243	8.6	6	0	94
*Cherries, edible portion		124	4.4	5	10	85
*Cranberries, as purchased		210	7.5	3	12	85
*Grapes, as purchased, av		136	4.8	5	15	80
Grape fruit		215	7.57	7	4	89
Grape juice	Small glass	120	4.2	0	0	100
Gooseberries		261	9.2	5	0	95
*Lemons		215	7.57	9	14	77
Lemon juice		246	8.77	0	0	100
Nectarines		147	5.18	4	0	96
Olives, ripe	About seven	37	1.31	2	91	7
*Oranges, as purchased, av	One very large	270	9.4	6	3	91
Oranges, juice	Large glass	188	6.62	0	0	100
*Peaches, as purchased, av	Three ordinary	290	10.	7	2	91
Peaches, sauce	Ord. serving	136	4.78	4	2	94
Peaches, juice	Ordinary glass	136	4.80	0	0	100
*Pears	One large pear	173	5.40	4	7	89
Pears, sauce		113	3.98	3	4	93
*Pineapples, edible portion, av		226	8.	4	6	90
Raspberries, black		146	5.18	10	14	76
Raspberries, red		178	6.29	8	0	92
*Strawberries, av	Two servings	260	9.1	10	15	75
*Watermelon, av		760	27.	6	6	88

DAIRY PRODUCTS

Name of Food	"Portion" Containing 100 Food Units (approx.)	Grams	Oz.	Protein	Fat	Carbohydrate
*Butter	Ordinary pat	12.5	.44	.5	99.5	00
*Buttermilk	1½ glass	275	9.7	34	12	54
*Cheese, American, pale	1⅓ cubic in	22	.77	25	73	2
*Cheese, cottage	4 cubic in	89	3.12	76	8	16
*Cheese, full cream	1⅓ cubic in	23	.82	25	73	2
*Cheese, Neufchatel	1⅓ cubic in	29.5	1.05	22	76	2
*Cheese, Swiss	1⅓ cubic in	23	.8	25	74	1
*Cheese, pineapple	1⅓ cubic in	20	.72	25	73	2
*Cream	¼ ord. glass	49	1.7	5	86	9
Kumyss		188	6.7	21	37	42
*Milk, condensed, sweetened		30	1.06	10	23	67
*Milk, condensed, unsweetened		59	2.05	24	50	26
*Milk, skimmed	1½ glass	255	9.4	37	7	56
*Milk, whole	Small glass	140	4.9	19	52	29
Milk, human, 2nd week		162	5.7	11	47	42
Milk, human, 3rd month		171	6	7	46	47
*Whey	Two glasses	360	13	15	10	75

CAKES, PASTRY, PUDDINGS AND DESSERTS

Name of Food	"Portion" Containing 100 Food Units (approx.)	Grams	Oz.	Protein	Fat	Carbohydrate
*Cake, chocolate layer	Half ord. sq. pc.	28	.98	7	22	71
*Cake, gingerbread	Half ord. sq. pc.	27	.96	6	23	71
Cake, sponge	Small piece	25	.89	7	25	68
Custard, caramel		71	2.51	19	10	71
Custard, milk	Ordinary cup	122	4.29	26	56	18
Custard, tapioca	Two-thirds ord.	69.5	2.45	9	12	79
*Doughnuts	Half a doughnut	23	.8	6	45	49
*Lady fingers	Two	27	.95	10	12	78
*Macaroons	Flour	23	.82	6	23	61
*Pie, apple	One-third piece	38	1.3	5	32	63
*Pie, cream	One-fourth piece	30	1.1	5	32	63
*Pie, custard	One-third piece	55	1.9	9	32	59

CAKES, PASTRY, PUDDINGS AND DESSERTS—Continued

Name of Food	"Portion" Containing 100 Food Units (approx.)	Wt. of 100 Calories Grams	Oz.	Per cent of Protein	Fat	Carbo-hydrate
*Pie, lemon	One-third piece	38	1.35	6	36	58
*Pie, mince	One-fourth piece	35	1.2	8	38	54
*Pie, squash	One-third piece	55	1.9	10	42	48
Pudding, apple sago		81	3.02	6	3	91
Pudding, brown betty	Half ord. s'v'g	56.6	2.	7	12	81
Pudding, cream rice	Very small s'v'g	75	2.65	8	13	79
Pudding, Indian meal	Half ord. s'v'g	56.6	2.	12	25	63
Pudding, apple tapioca	Small serving	79	2.8	1	1	98
Tapioca, cooked	Ord. serving	108	3.85	1	1	98

SWEETS AND PICKLES

Name of Food	"Portion" Containing 100 Food Units (approx.)	Grams	Oz.	Protein	Fat	Carbo-hydrate
*Catsup, tomato, av		170	6.	10	3	87
Candy, plain		26	.9	0	0	100
Candy, chocolate		30	1.1	1	4	95
*Honey	Four teaspoons	30	1.05	1	0	99
*Marmalade (orange)		28.3	1	.5	2.5	97
*Molasses, cane		35	1.2	.5	0	99.5
*Olives, green, edible portion	Five to seven	32	1.1	1	84	15
*Olives, ripe, edible portion	Five to seven	38	1.3	2	91	7
*Pickles, mixed		415	14.6	18	15	67
*Sugar, granulated	Seven level teasp. or 3½ lumps	24	.86	0	0	100
*Sugar, maple	Four teaspoons	29	1.03	0	0	100
*Syrup, maple	Four teaspoons	35	1.2	0	0	100

NUTS, EDIBLE PORTION

Name of Food	"Portion" Containing 100 Food Units (approx.)	Grams	Oz.	Protein	Fat	Carbo-hydrate
*Almonds, av	Eight to fifteen	15	.53	13	77	10
*Beechnuts		14.8	.52	13	79	8
*Brazil Nuts	Three ord. size	14	.49	10	86	4
*Butternuts		14	.50	16	82	2
*Cocoanuts		16	.57	4	77	19
*Chestnuts, fresh, av		40	1.4	10	20	70
*Filberts, av	Ten nuts	14	.48	9	84	7
*Hickory nuts		13	.47	9	85	6
*Peanuts, av	Thirteen double	18	.62	20	63	17
*Pecans, polished	About eight	13	.46	6	87	7
*Pine nuts (pignolias)	About eighty	16	.56	22	74	4
*Walnuts, California	About six	14	.48	10	83	7

CEREALS

Name of Food	"Portion" Containing 100 Food Units (approx.)	Grams	Oz.	Protein	Fat	Carbo-hydrate
*Bread, brown, average	Ord. thick slice	43	1.5	9	7	84
*Bread, corn (johnnycake), av	Small square	38	1.3	12	16	72
*Bread, white, home made	Ord. thick slice	38	1.3	13	6	81
*Cookies, sugar	Two	24	.83	7	22	71
Corn flakes, toasted	Ord. cer. dish f'l.	27	.97	11	1	88
*Corn meal, granular, av	2½ level tbsp.	27	.96	10	5	85
Corn meal, unbolted, av	Three tbsp	26	.92	9.	11.	80
*Crackers, graham	Two crackers	23	.82	9.5	20.5	70
*Crackers, oatmeal	Two crackers	23	.81	11	24	65
*Crackers, soda	8½ level tbsp.	27	.96	10	5	85
*Hominy, cooked	Large serving	120	4.2	11	2	87
*Macaroni, av		27	.96	15	2	83
*Macaroni, cooked	Ord. serving	110	3.85	14	15	71
*Oatmeal, boiled	1½ serving	159	5.6	18	7	75
*Popcorn		24	.86	11	11	78
*Rice, uncooked		28	.98	9	1	90
*Rice, boiled	Ord. cereal dish	87	3.1	10	1	89

CEREALS—Continued

Name of Food	"Portion" Containing 100 Food Units (approx.)	Wt. of 100 Calories Grams	Oz.	Per cent of Protein	Fat	Carbo-hydrate
*Rice, flakes	Ord. cereal dish	27	.94	8	1	91
*Rolls, Vienna, av	One large roll	35	1.2	12	7	81
*Shredded wheat	One biscuit	27	.94	13	4.5	82.5
*Spaghetti, average		28	.97	12	1	87
*Wafers, vanilla	Four	24	.84	8	13	71
*Wheat, flour, e't'e wheat, av	Four tbsp	27	.96	15	5	80
*Wheat, flour, graham, av	4½ tbsp	27	.96	15	5	80
*Wheat, flour, patent, family and straight grade spring wheat, av	Four tbsp	27	.97	12	3	85
*Zweiback	Size of thick slice of bread	23	.81	9	21	70

MISCELLANEOUS

Name of Food	"Portion" Containing 100 Food Units (approx.)	Grams	Oz.	Protein	Fat	Carbo-hydrate
*Eggs, hen's boiled	One large egg	59	2.1	32	68	00
*Eggs, hen's, whites	Of six eggs	181	6.4	100	0	00
*Eggs, hen's, yolks	Two yolks	27	.94	17	83	00
*Omelet		94	3.3	34	60	6
*Soup, beef, av		380	13.	69	14	17
*Soup, bean, av	Very large plate	150	5.4	20	20	60
*Soup, cream of celery	Two plates	180	6.3	16	47	37
*Consomme		830	29.	85	00	15
*Clam chowder	Two plates	230	8.25	17	18	65
*Chocolate, bitter	Half-a-square	16	.56	8	72	20
*Cocoa		20	.69	17	53	30
Ice Cream (Philadelphia)	Half serving	45	1.6	5	57	38
Ice Cream (New York)	Half serving	48	1.7	7	47	46

Experiment 132. To plan meals for a day for a definite cost, with the general proportion of nutrients and the right number of calories per day.

Prepare and serve one of these.

Experiment 133. To make a list of good and bad combinations for the three meals.

Give reasons for each.

REFERENCE. "Some Points to Be Considered in the Planning of a Rational Diet," by Susannah Usher. Household Science Dept. Bulletin, University.

CALCULATION OF A DAY'S MEALS FOR A HIGH SCHOOL GIRL WEIGHING ABOUT 115 POUNDS, ALLOWING 20.4 CALORIES PER POUND.

(S. P. means Standard Portion of 100 Calories.)

BREAKFAST.

	S. P.	*Protein Calories.*	*Fat Calories.*	*Carbo. Calories.*	*Total.*
Breakfast.					
Orange	1	6	3	91	100
Bacon	2	12	188	.....	200
Shredded wheat...	1	13	4.5	82.5	100
Sugar	2	....	.....	100	100
Cream	1½	10	122	18	150
Toast	1	13	6	81	100
Butter	1	.5	99.5	.....	100
Coffee	...	....	.....	.....	...
	...	54.5	423.0	372.5	850
Luncheon.					
Rice and	1	10	1	89	100
Cheese	½	12.5	36.5	1	50
Vegetable salad ..	...	....	100	.....	100
French dressing ..	1	....	.....	.....	...
Stewed apricots ..	1	6	.....	94	100
Doughnut	2	12	90	98	200
Milk	1	37	7	56	100
	...	132.0	657.5	710.5	1,500
Dinner.					
Vienna Roll	1	12	7	81	100
Butter	1	.5	99.5	.....	100
Consomme	¼	21.5	.....	3.5	25
Lamb Chops	2	48	152	.....	200
Baked Potatoes...	1	11	1	88	100
Butter	2	1	199	.....	200
Stewed Tomatoes	⅓	7	2	24	33
Baked Custard...	1	26	56	18	100
Total for the day ...		259.0	1,174.0	925.0	2,358

This day's menus give about 1/10 the total number of calories from protein, and do not give a heavy, starchy diet.

The following variations from the menus calculated are often used, making a diet too high in protein:

Breakfast Variation	*Luncheon Variation*	*Dinner Variation*
Orange	Rice and Cheese	Roll and Butter
Ham	Creamed Dried Beef	Consomme
Eggs	Vegetable Salad	Lamb Chops
Shredded Wheat	Stewed Apricots	Macaroni and Cheese
Sugar	Doughnuts	Stewed Tomatoes
Cream	Milk	Baked Custard
Toast		
Coffee		

Fruits and juicy vegetables are frequently omitted from the diet and starchy vegetables, cereals and starchy puddings used in their stead. Following is a list of good and bad combinations at a meal:

Good Examples	*Bad Examples*
Irish Potatoes	Irish Potatoes
Peas	Sweet Potatoes
Lemon Jelly	Rice Pudding or
Potatoes or Rice	Cornstarch Pudding
Vegetable Salad	Potatoes or Rice
Lettuce	Corn
Tomatoes	Bananas
Cucumbers	Cereal Breakfast Food
Oranges and Bananas (Sliced)	Griddle Cakes
Griddle Cakes	
Bacon	

CHAPTER XXVII

TABLE SERVICE

One of the most frequently disputed questions connected with the subject of serving is the correct method of setting the table. For example, one person tells us that the spoons should be placed at the side of the knife, another that they should be put just beyond the plate. Which is right? Today the effort is being made to lessen the work of women in the home. If this end is to be achieved, it becomes necessary to cease doing a thing just because some one says it is *the* way to do it. We must have a reason underlying the things that we do. May it not be possible that there is more than one way of placing the spoons on the table, and that each is equally correct?

The meal time, especially the dinner hour, is the time when the average family enjoys a little respite from the strenuousness of the day. Therefore, there must be some symmetry to the arrangement of the china and silver that it may not be confusing and tiring to the eye. There must also be a quiet handling of these things that the family may feel that the meal is one of comfort. But these ends are not necessarily accomplished in only one way.

In both the setting of the table and the serving, three things should be kept in mind. First, there should be simplicity. To go into a dining room ornately decorated, to sit down at a table piled high with dishes, center pieces, and food, tends to give a sense of weariness at the beginning of the meal. To enter a dining room which is simply decorated, which has only the necessary and convenient furniture, to sit down at a table where the decorations do not prevent a full view of the person opposite, and where a glance at the table shows the useful equipment and but little more, gives a feeling of rest which enhances the enjoyment of the food, no matter how simple.

The second point to note is that of good arrangement. It is far more pleasing to the eye to have the knives and forks placed on the table parallel to one another than to have them look as though they had been carelessly dropped there. It is more pleasing to have the tablecloth on straight, the individual service, that is, the silver, glass, and linen which go at each place, put on the table so that one place is easily distinguished from another, than to have a confusion of lines which comes from lack of attention to these points. It is better to have the glasses filled only about three-fourths full instead of almost overflowing, so that one hesitates to move the glass for fear of an accident. All these things tend to give to the table an appearance of good

design, which is as restful as the simplicity of it. Last, a table cannot be said to be well set, or the serving perfectly done, if things are not convenient. Simplicity and good design might tell us that it is proper to put all the spoons to the right of the knife, but if by so doing the next place is crowded, convenience would suggest putting them beyond the plate.

Setting the Table

Coverings. There are, in general use, two ways of covering the table: One, covering the whole table; that is, using a tablecloth; the other, covering only portions of the table by the use of center piece and doilies, or a lunchcloth. Sometimes the tablecloth is used for the dinner, and doilies or lunchcloth for the other two meals. The use of small pieces of linen in place of the larger tablecloth is often a great saving of labor. Tablecloths must be ironed when they are very damp, in order to give them a smooth, glossy finish. To iron a three-yard tablecloth well means the work of at least forty-five minutes. When one or two spots are made on the cloth it necessitates washing it, while in the case of doilies, the soiled ones may be removed and others substituted, which means comparatively little work to keep the linen on the table clean. Unless, however, the table is well finished, a tablecloth is preferable.

Protecting the Table. When any highly polished table is used it should be protected in some way from the heat of dishes. A pad of heavy canton flannel, table felt, or asbestos is generally used under the cloth. These are sometimes spoken of as "silence cloths," because the sound of the dishes is deadened by them. When doilies are used it is necessary to use asbestos or felt mats beneath those on which the hot dishes are to be placed.

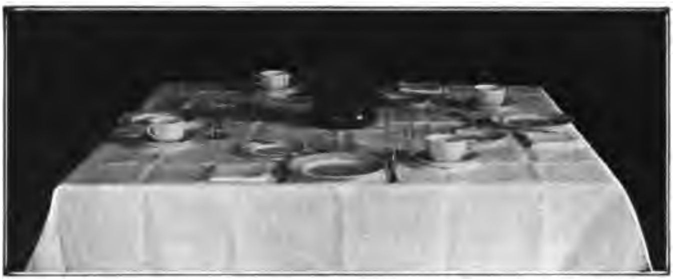


Plate 28.—A Table Simply Set for Breakfast or Luncheon.

Laying the Cloth. The tablecloth should be placed over the silence cloth with the crease directly down the middle, and the cloth spread smooth from the center out. The cloth should hang over the ends an equal distance, or, in the case of a round table, the four corners of the cloth should be equidistant from the floor.

Placing the Doilies and Lunchcloth. When doilies are used for the table, each place is usually set with three: one for the plate, one for the bread and

butter plate, and one for the glass. If tea, coffee, or chocolate is to be served, a fourth doily is sometimes used. The method of placing a lunchcloth on the table depends upon the size and design of the cloth, and upon the size of the table. It is sometimes placed with edges parallel to those of the table, sometimes with a corner dropping over each side of the table. If the table is round, the latter method

Plate 29.—A Table Set for Three Courses.

must be used. In either case, the cloth should be laid evenly.

Placing of Individual Service. In order to give sufficient room for comfort, there should be twenty-five to thirty inches between the plates. To the right of the space for the plate is placed the knife with the sharp edge toward the plate. This is the most convenient way because it requires turning the knife only half way over in order to use it. The fork is placed at the left of the plate with the tines up. Both the knife and the fork are placed at a distance

of three-fourths of an inch to one inch from the edge of the table. This lessens the chance of knocking them out of place when sitting down to the table. The distance between the knife and the fork depends upon the size of the largest plate to be used. A general guide is that of having the knife placed a little over its own length away from the fork. The teaspoons are placed, bowls up, either to the right of the knife or beyond the plate, according to the

Plate 30.—A Variation from Plate 28 in the Arrangement of the Silver.

amount of room or the number of pieces of silver to be used. The water glass is placed about one-half of an inch from the point of the knife, where it is easily reached with the right hand. The bread and butter plate is placed slightly to the left of the end of the fork, and, like the glass, about a half inch beyond. The butter spreader is placed on the butter plate across the farther side, with the edge of the blade turned in and the handle toward the right of the butter plate. This makes the easiest position from which to grasp it with the right hand.

Sometimes the butter spreader, like the rest of the silver, is placed on the cloth, but on account of its size it is very likely to be overlooked, the edge of the butter plate obscuring it from view. The butter is placed toward the outside of the plate, not in the middle. This, then, gives room for the roll or bread. The napkin is placed to the left of the fork with the open edges next to the fork and the edge of the table, and the fold away from the edge. If individual salts and pepper shakers are used, they are placed beyond the plate; otherwise, between the places, or, if there are but two sets, so arranged as to be convenient to the largest number of persons.

The foregoing constitutes individual service. Very often additional silver is used. In this case silver of the same kind, such as forks, are placed next to each other in the order in which they are to be used, starting from the outside, or else they are placed according to size. The former is the more usual method because it is less likely to cause confusion through the use of the wrong piece of silver for a certain course. There is an exception to this in the case of the small fish fork sometimes used. This is placed to the right of the knives and any spoons which may be there. A soupspoon is, usually, placed at the right of the knives, and the teaspoons beyond the plate. If knives, teaspoons, soupspoons, and oyster fork are all placed in a line, it gives an appearance of display which is not pleasing.

Serving

Forms of Service. There are three forms of service commonly in use, the English, the Russian, and the "compromise." In the English service all the food to be served at one simple meal, or at one course, is placed on the table at the beginning to be served by the host or hostess. The meat is on platters, the vegetables in suitable dishes, and the service is planned so as to necessitate no one's rising from the table during the meal or course.

The Russian service is just the opposite of the English. All the serving is done from the serving table or pantry. There is no food on the table at the beginning of the meal save the candy, nuts, and relishes. This method of service, of course, requires a servant, or that some one of the family remain away from the meal.

The compromise service is one which has points taken from both the English and the Russian, and is the one used by the majority of people because the meal can be served without outside help, or with the minimum of it. In the compromise service the meal is often served in courses, but at the beginning of each course all the food for that course is placed on the table. Sometimes the salad and dinner courses are put on the table together, especially if one of the members of the family is doing the serving. When this is done less rising from the table is required, and thus there is less interference with the conversation

at the meal. Everything should be planned so as to make the serving expeditious and with as little offense to the eye and ear as possible.

Directions for serving which are given here are not made primarily with the thought that there is to be a maid, but rather that one member of the family may serve by rising quietly between the courses, and not by staying away from the table.

There is nothing that spoils the conversation at the meal more, or makes a guest feel more uncomfortable, than for one of the family to have to stay away from the table in order to serve. It is much better to use less service and maintain a pleasant, unbroken hour.

Placing of Dishes. Always serve from the left anything which is to be taken from the dish by the person sitting at the table. This is so that the right hand may be conveniently used. In putting dishes before a person they may be placed either from the left or from the right, but it avoids confusion, however, to use one side as much as possible, and since the water and any beverage which is to be used must be placed at the right in order not to pass in front of the person, this is the better side to use.

Order of Serving. In seating guests, the guest of honor, if a man, should be seated at the right of the hostess; if a woman, at the right of the host. The order in which to serve may be varied. It depends

upon the numbers to be served and personal preference. Either of the following methods is correct:

1. Serve all the women before the men, beginning with the hostess or the guest of honor.

2. Serve the guest of honor or hostess first, then the next person to her, irrespective of whether a man or woman, old or young, continuing around the table until all are served. When there is a large number at the table and this plan is used, it is often wise to serve one course to the left and the next to the right, thereby preventing either side from always being last.

Many people prefer beginning with the hostess rather than with the guest of honor, feeling that she has an opportunity to see that things are right so far as the serving is concerned. This, of course, could not be done unless there were a host, providing something is being served on the table, for then the hostess would be engaged in serving. The hostess always takes the initiative in beginning to eat.

Removing Dishes. Remove the larger dishes, such as the platter and vegetable dishes, first, then any smaller things, such as bread plates, which are not individual service. Last, remove the individual things from the right of the person. In removing large dishes use two hands where the dishes are at all heavy. Even if it seems a little awkward, it is better than taking any chance of letting the dish slip. The individual things, which are removed last, are taken from the right-hand side. Be careful that

dishes are not placed one upon the other. A tray may be used in removing the individual service, thus saving many steps. In refilling glasses always take them up at the bottom. Never let the fingers touch the upper rim of the glass. Fill the glasses only three-fourths full. Before bringing in the dessert remove everything that does not pertain directly to that course and take the crumbs away. In removing the crumbs, use a plate and a folded napkin for a bare table. A silver crumb knife in place of a napkin may be used for a tablecloth. A crumb brush is objectionable because it is difficult to keep clean. Both in serving and in removing dishes a folded napkin may be used on the left hand in place of a tray.

If at any time during the serving of a meal a piece of silver is dropped, a glass of water spilled, or any other accident occurs, remove all traces of the trouble as quickly and as quietly as possible, so that the one who was responsible will not be made to feel any more uncomfortable than is necessary.

Whenever an unusual condition arises in serving, meet it by applying the general principles before mentioned of simplicity, good design, convenience, and comfort.

CHAPTER XXVIII

THE HYGIENE OF FEEDING

The nourishment of the body is measured not by the food taken in, but by what it absorbs and makes into cell material. These conditions are influenced by the amount of general exercise, bathing, warmth of clothing, habits of eating, and by frame of mind.

Food may be of the right kind, the right quantity, and perfectly cooked, and yet the body may not be nourished by it. Some conditions not sufficiently considered in that connection will be discussed first.

Conditions of Good Digestion. Digestion, like all other functions of the body, is controlled by the nervous system. The secretion of digestive juices and movements of the various organs of that system are affected by whatever affects the nervous system. The emotions of fear, worry, grief, anger, and homesickness may be the cause of indigestion lasting long after the passing of the emotion. Worry has been known to keep food in the stomach undigested, just as it entered, for over 12 hours. Food should always be taken leisurely, and under pleasant conditions. Tales of suffering, petulant rehearsals of household or business cares, or any conversation likely to bring unpleasant memories or ideas have no place at the

table. If children must be corrected at the table, it should be done quietly, with as much respect for their feelings as though they were adults. To create a "scene" at table spoils the enjoyment of the meal for all, and is often the unsuspected cause of digestive disturbances in children as well as adults.

Fatigue, which means the presence in the body of poisons formed by work, should be a sign to refrain from eating. These fatigue poisons unfit every kind of cell in the body for doing its work properly. Fatigue calls for absolute relaxation and rest to keep the body from forming more poisons, and to give it time to throw off what have been accumulated.

Perhaps the most serious and persistent offenses in the hygiene of feeding are slight mastication and overeating, the first being largely to blame for the second. Insufficient mastication, like fatigue and the emotions mentioned above, means that the food must remain in the stomach a longer time than it should. Here are found bacteria with warmth and food for their growth. Decomposition begins and continues in the intestines. The digestive juices are hindered also by the large quantity of material. Some of the products of decomposition the body may be able to use as food, but many it cannot. These products are all absorbed into the blood stream, from which they go to the cells producing autotoxication, self-poisoning, which shows itself in

general ill-health, possibly anemia, headache, sleeplessness, fatigue, and hives.

Arterio-sclerosis, or hardening of the arteries, is not a disease following immediately upon misdemeanors of this kind, but it comes in mature or later life as a result of heavy protein feeding accompanied by intestinal decomposition.

Mr. Horace Fletcher, by his experiments in thorough mastication and the excellent results in health, has aroused much interest in the problems of feeding. In middle life his health was in poor condition. He concluded the trouble lay in digestion. He began to eat only when he felt the call of appetite, and he masticated what food he did eat until he could no longer hold it in his mouth. By doing this he so improved his health and endurance that without more exercise than one would get in walking about the streets of a town on ordinary business, Mr. Fletcher made a 100-mile run on a bicycle with no results of soreness or stiffness, whereas a man who was in training for this feat could not complete the distance. Now, at over sixty years of age, Mr. Fletcher is an unusually vigorous man both mentally and physically. He holds records for endurance tests made in the gymnasium at Yale surpassing those of trained athletes.

These results have followed excellent digestion and absorption of food, due to its small quantity and to thorough mastication. There is no decompo-

sition occurring, for instead of a daily evacuation of feces there are only one or two a week, and these are without odor, as they should be. Such a condition prevents the fatiguing of cells by decomposition products. It lessens the time necessary for rest and sleep. People who have begun to masticate thoroughly seem to instinctively eat less protein in proportion to the amount of food than formerly. This has no small share in producing odorless feces. You have already learned that protein foods are most suited to bacterial growth outside the body.

Eye-Strain. An often unsuspected cause of indigestion, as well as of other ills, is eye-strain. This may be due either to lack of glasses or to incorrect ones. In such a case seek the advice of a competent oculist who has had a thorough course of training in his profession. Many persons have been subject to a continued series of illnesses by wrong glasses.

Appetite. It is an old saying, "Stop while you are still hungry." It is easier to say what hunger is not than what it is. A gnawing sensation seeming to originate in the stomach and extend to the back of the mouth is often taken as a sign of hunger. This is a ravenous feeling and leads its victims to hurry, poor mastication, and overeating. It seems to have no relation to the body's need for food. Its tendencies should be disregarded. Drink plenty of water and eat slowly and lightly under such conditions. Few but the very poor and those

recovering from a wasting disease, know what real hunger is. If the appetite is not abused by overeating, or a sedentary life, it is a good guide as to quantity when accompanied by thorough mastication. Appetite might be described as a delicate relish for food. Appetite ceases when a feeling of complete satisfaction arrives. One should stop eating before the appetite is entirely satisfied.

When food gives off agreeable odors, or is appetizing in appearance, the "mouth may water," a popular way of saying that saliva is secreted by the sight or smell of food. Gastric juice also flows at least one-half hour before it would if the food were unappetizing. This may be called psychic juice. It shortens the time necessary to digest food, but does not seem to increase the amount digested, as was once supposed.

Drinking During Meals. There has been much controversy regarding drinking during meals. At last experiments have been performed by Hawk which seem to show that the more water drunk at meals the better. Of course, it should not be taken when food is in the mouth, since it would be likely to carry the food with it before mastication has been sufficient.

After the eating of a meal neither vigorous exercise nor a hot bath should be taken. These take too much blood away from the digestive organs to the muscles and skin. Mental work does not

demand enough blood in the brain to interfere with digestion. If fatigue is felt when mental work is undertaken after a meal it is due to overeating or general causes. In hot weather, when much blood is on the surface and perspiration is profuse, eat lightly. Eat very little protein food, for in the process of assimilation this, unlike carbohydrates and fats, must be broken up, a process which evolves heat, thus adding to the body's burden of cooling.

"Stuff a cold and starve a fever" is an unwise rule. Stuff neither. Feeding should be light during a cold, although there is a temporary relief to head congestion during a meal. This is another case of deranged nervous system necessitating as little strain as possible on any function of the body.

With all of the foregoing precautions taken, unless the teeth are kept clean, free from decay, the food will be contaminated at its entrance to the body and poor absorption and assimilation will result.

Make a list of rules as an extract of this chapter to be used as your guide to hygienic feeding.

SANITATION

INTRODUCTION

Sanitation, or sanitary science, is that body of information which deals with the maintenance of health and long life, and with the prevention of disease. It may be divided into two groups of topics: First, those which are purely personal, and, second, those which affect two or more persons. The following list of topics will show the scope of the science:

Group 1

a. Diet.
b. Feeding.
c. Clothing.
d. Exercise.
e. Bathing.
f. Care of the teeth.
g. Care of the eyes.

Group 2

a. Relating to the spreading of infection.
1. Care and use of the hands.
2. Use of handkerchiefs, towels, and bedding.
3. Drinking cups and dishwashing.
4. Use of mouth, coughing, and sneezing.
5. Kissing.

b. Relating to environment which affects vigor or vitality.
1. Cleanness of soil under the house.

2. Freedom of surrounding country from breeding places of flies and mosquitoes.
3. Openness of house to sun and moving air.
4. Heating of the house, without overdrying the air.
5. Lights which are like daylight, with no glare or poisonous products.
6. Plumbing which automatically cleans itself, leaving no trace of odor.
7. Garbage and sewage disposal which does not spread contagion nor create a nuisance.
8. An uncontaminated water supply.
9. Clean food supply.
10. House as free as possible from dust and infectious particles.
11. Use of disinfectants and scrubbing materials.

The subject of individual sanitation will be left to the study of hygiene in connection with physiology. The topics of *Group 2* will, alone, be undertaken in this book. The subjects of house planning and furnishing in detail will be left for a special course. It may be said, in passing, that no more satisfactory basis for such a course can be found than Mr. Daniels's *Furnishing a Modest Home,* which should be in the hands of all who desire artistic and usable homes.

CHAPTER XXIX

THEORIES OF DISEASE

That well-known story of the casting out of devils from a sick man into swine illustrated one theory of the cause of disease. The savage custom of beating instruments and making unbearable noises to drive out the devils of sickness showed the same idea. The Chinese custom of so hideously painting the body of the sick and placing it outside the house so that the devils would not leave it and return to visit some other member of the family went a little farther in paying unknown respect to the possibilities of infection.

According to the "Father of Medicine," Hippocrates, 400 B.C., disease was caused by a wrong adjustment of the humors of the body: Blood, black bile, yellow bile, and phlegm. We still use the idea and its phraseology to describe temperaments:

1. Sanguine, plenty of blood, bright and cheerful.
2. Melancholy, too much black bile.
3. Bilious, too much yellow bile.
4. Phlegmatic, too much phlegm, slow.

Later, in the 18th and 19th centuries, arose various physical and chemical theories of disease. Not until 1863, the breaking out of the Civil War, was it

shown that disease may be caused by the implanting in a healthy body of a particular kind of micro-organism. This theory had been proposed 100 years before, but no proof had been made. The steps necessary to make the proof possible were taken after 1683.

a. In that year a Dutch lens maker, Leewenhoek, made a lens so powerful that he could see living things of unknown nature in the scrapings from teeth. This discovery he spread, and microscopes and lenses were more and more improved until in 1786 a classification of bacteria, according to their form, could be made. Not until 74 years later, however, was the part played by bacteria in disease discovered and proved.

b. By about 1860, Louis Pasteur, the "Father of Bacteriology," and Tyndall, the great English physicist, proved that air, free from all particles, does not cause fermentation and decay. This, at last, killed the theory of spontaneous generation; that life may come from something totally unlike it. It was believed that the bacteria were produced by fermentation and decay, which was due to the presence of air, just as it was thought that frogs and ducks sprang from the mud of ponds and streams. These men proved that bacteria caused the fermentation or decay; that air, free from them, would not produce fermentation or decay. So recent is this discovery that many otherwise well-educated people

still speak of air as causing the decay of canned fruit.

c. Next it was proved that a disease from which the silk worms in France were suffering was caused by bacteria. Pasteur saved the silk industry by this wonderful discovery. In 1863 it was discovered that anthrax in cattle was also due to bacteria, and that the disease could be spread from one animal to another by the transfer of these bacteria.

d. In 1882 Robert Koch invented gelatin and agar culture media so that germs could be kept separated and each individual kind studied by itself. These culture media made possible, in the last twenty years of the century, the discovery of the specific organisms causing most of the infectious diseases. Now we know that tonsilitis, diphtheria, all kinds of colds, tuberculosis, typhoid, diarrhea, hydrophobia, boils, sores, abscesses, blood poisoning, pneumonia, whooping cough, measles, mumps, scarlet fever, smallpox, and probably rheumatism, are all due to the transfer of certain germs from the body of a sick person, or other breeding place, to the body of another person. If, for instance, all germs which are excreted by all typhoid patients at this time were killed immediately, or so disposed of that they could not reach another body free from typhoid, then that disease would cease to exist.

With this certainty of the cause of all these diseases it is now only ignorance, or almost criminal

carelessness, which allows an epidemic to spread from one member through a family. To prevent the spread of infectious diseases, those caused by micro-organisms, three things must be known:

1. How these germs get out of the sick body.
2. What their resistance is to conditions outside the body; *e. g.,* temperature and dryness.
3. How they are carried to another body and how they enter it.

Many kinds of disease-producing germs are found permanently in the body. They are held in subjection by the healthiness of the body. An instance of great fatigue, prolonged exposure to cold, under or over feeding, or lack of exercise, might give these a chance to show the symptoms of their particular disease. If, through some carelessness, some of these germs, apparently inactive in a very healthy person, are introduced into the body of someone who is in some way below normal in health, or is particularly susceptible to a certain kind of germ, then, that person may have the disease in virulent form. This makes it necessary to form habits of sanitary practices, not try to take them on only when disease breaks out.

CHAPTER XXX

HOW TO AVOID DISEASE

HABITS WHICH WILL HELP TO AVOID DISEASE

1. Do not touch the hands or fingers to the mouth or lips or to any mucous surface without thoroughly washing them before and immediately afterwards. The fingering of the face is bad manners, not only because it annoys others, but because it is likely to carry germs to the skin and cause pimples or something worse. It may infect other parts which the hands may touch with germs from the parts.

2. Keep the nails as well as the skin of the hands clean. Dirt is generally accompanied by germs. Plenty of hot water, soap, a nail brush, a nail file, and an orange-wood stick are necessary if you would have clean hands.

3. Use individual towels, pillow covers and other bedding, combs, brushes, clothing, and soap. By all means do not use public soap. Children should always have their own handkerchiefs, and use them when they have them. The importance of this is obvious. If you watch you will see a towel used in common by several people, as a hand towel in a kitchen and those in public places, applied to hands as well as lips. The water bucket in the kitchen

is often dipped into with a dipper or a cup used in common by all members of the family. This is unsafe practice.

4. Thoroughly wash all dishes or utensils used in eating or drinking before they are used by another. This does not show unfriendliness, but rather the greatest kindness.

5. After buying, wash all clothing to be worn next the body before wearing it.

6. Never carry handkerchiefs in the hand, nor leave them about on desk, chairs, etc. Keep them in some sort of pocket.

7. Do not wet the fingers to turn the leaves of books or papers.

8. Never put money, or pencils, or pins, or needles, or thread, into the mouth. Do not use the mouth to hold things, nor as scissors, nor as a bowl of water.

9. Always cover the mouth when coughing, or the nose when sneezing. In the spray thrown out many germs are likely to be found. These may be carried as far away as 20 feet and stay in the air for as long as half an hour. They may contaminate food, dishes, or the lips or skin of other people.

10. If you want to taste another's apple, for instance, have a piece cut off, do not bite the apple. Use a clean spoon for tasting. Do not put it back into the mixture.

11. Do not spit upon any floor or walk. Use a handkerchief, a suitable cloth, or a piece of paper

which may be burned, if a bathroom is not at hand. Tuberculosis and pneumonia patients should use sputum cups.

12. Do not kiss promiscuously. When you do kiss, the cheek is a safer place than the lips. Babies and other young children are the helpless victims of ignorance in this respect.

Habits Promoting Good Resistance

1. Accustom the whole body to sudden but short and decided changes of temperature. Do not unduly cool it, if avoidable. Wear light-weight, porous clothing.

2. Keep up daily, moderate exercise.

3. Eat very moderately, with plenty of fruits and vegetables; masticate thoroughly, and avoid eating when fatigued, chilled, or overheated or excited.

4. Sleep in a room where the air is cool and moving, under light-weight covers, for at least eight hours per day. Do not live in a temperature higher than 68° F. and keep a window open.

5. Drink at least two quarts of water a day, one or two glasses with meals, the rest between meals.

6. Do not allow yourself to become over-tired, if avoidable. Learn to relax and rest in a very short time. Be happy, interested, calm, well-poised, and busy.

Try to make these practices habits as unconscious as breathing.

CHAPTER XXXI

HOW TO AVOID INFECTIOUS DISEASES

The spreading of infectious diseases may be somewhat better understood and prevented by a short discussion of some of the more common ones.

1. Colds, Tonsilitis, Bronchitis, Pneumonia, Diphtheria, Inflammation of the Eyes

Many people fail to understand that a cold or a sore throat is due to bacteria, although they are well aware of the dangers of the more serious throat diseases. As a matter of fact colds are often the forerunners of the more serious infections. A simple nose cold deserves as much care to prevent further infection as pneumonia.

The bacteria are found in the nose, mouth, throat, and eyes.

They escape by: 1. Droplets in coughing or sneezing or even in talking, onto handkerchiefs or cloths or into the air.

2. Food, utensils, towels, napkins, drinking cups, pillows, sheets, pencils put into the mouth, bitten thread, anything coming into contact with secretions of the mouth or nose.

They enter: 1. By the mouth.

2. By rubbing the eyes with infected fingers or handkerchiefs, or infected skin with clean fingers or handkerchiefs.

Resistance: 1. Germs in moist sputum are killed by boiling for five minutes.

2. If the sputum is allowed to dry, the germs may live as dust for several months. This makes strong demands for soaking or burning cloths before the discharges are dry.

Precautions: 1. Change the cloths used for sneezing, coughing, and spitting so frequently that they may not infect things of other persons.

In the throats of patients who have recovered from diphtheria and pneumonia the active germs of these diseases have been found after weeks and months. When quarantine is lifted, danger is not over. Moreover, what is apparently a simple cold may be caused by the germs which in others may produce pneumonia or diphtheria.

Tuberculosis

This disease, called the "Great White Plague," was the cause of 111,059 deaths in the United States in 1900, one-ninth of the deaths from all known causes. In loss of citizens and cost of caring for patients we spend, in the United States, from $150,000,000 to $200,000,000 per year.

Germs of this disease may lodge in any part of the body; bony, muscular, or mucous. It is believed that the germs which attack the lungs reach them by way of the digestive tract and then through the blood stream.

The bacteria escape from the body: 1. In the sputum by coughing, sneezing, and talking. An estimate has placed the number of droplets escaping from one patient in 24 hours as from 500,000,000 to 3,000,000,000. If not caught

in cloths or cups, they may remain in the air for one-half hour, to finally settle on any surface.

2. In the feces.

They enter the body: 1. On infected fingers put into the mouth; *e.g.*, children playing on a floor infected with tubercle bacilli.

2. Food infected by flies or other insects which have come in contact with sputum, or by milk and butter from tubercular cattle.

3. Imperfectly cleaned dishes.

Resistance: 1. In the soil of sewage fields, decaying sputum harbors active germs for weeks and months.

2. Dried sputum in a dark, cool place; *e.g.*, a dark, damp, unclean room may have active germs for six or eight months.

3. In completely dried dust they may last from eight to ten days.

4. Cold does not kill these germs.

5. Boiling for five minutes kills.

6. In a closed vessel, 140° F., for twenty minutes, kills them; the temperature and time that should be used for pasteurizing milk. If the vessel is open, one hour at this temperature does not kill these germs on account of the protection of the scum formed when milk is heated.

7. Dried sputum stands a temperature of boiling for one hour.

8. A 5% solution of carbolic acid requires 24 hours to kill the bacteria because of its slow penetration of the sputum.

9. Lysol, which dissolves mucus, is the best disinfectant to use.

10. Direct sunlight with abundant oxygen requires from 20 to 30 hours to kill germs if they are in sputum.

Precautions: 1. Let no droplets escape into the air.

2. Keep cloths in a paper receptacle while they are in use, then burn them.
3. Use a disinfectant in washing the dishes of the patient.
4. Disinfect any food left on the patient's plate before throwing it away.
5. The hands of the patient should be washed in disinfectant solution whenever there is a possibility of their being soiled.

Typhoid

In 1900 typhoid in the United States caused 35,379 deaths, and there were recorded 350,000 cases of it. Water supply contaminated by sewage is the cause of by far the most typhoid epidemics. The changing of the direction of the Chicago River to carry Chicago's sewage southwest into the river system emptying into the Mississippi, and the building of water intakes four miles out in the lake, has played a large part in bringing the death rate in Chicago down from 5.97 in 1891-1900 to 2.21 in 1901-1910.

Note. Cholera, another disease producing infected feces, but not found in this country fortunately, has been the cause of many plagues in Europe and Asia. It has been practically wiped out in northern Europe where sewage farms and filter beds have been constructed for the waste and water supply.

Germs leave the body: 1. In the urine and feces, not only of typhoid patients but of those suffering with gallstones.
2. In the rose spots on the abdomen in typhoid.
3. In the sputum when pneumonia develops with typhoid.

They enter the body through the tonsils and through the lining of the stomach.

They are carried by: 1. Water.

2. Milk.

3. Oysters growing in sewage-polluted beds.

4. Raw vegetables watered with sewage-polluted water.

5. Flies which have come in contact with infected feces.

6. Dust.

7. Carriers. Four per cent of all patients give off active germs from their bodies for from ten weeks to two years, and even longer after they are in all other respects perfectly well. There is a famous typhoid carrier called "Typhoid Mary," who, as a cook, infected several households before she was discovered as the cause of the cases.

Resistance: 1. Germs live in the ground or in surface water for from two to three weeks.

2. They live in a natural body of water; *e.g.,* lake, for at least five days, likely much longer.

3. In soil and feces they live longer than in water.

4. They have been found alive in five-month-old fecal material after it had been used as manure for two weeks.

5. They survive in ice when the sewage is not in minute particles; otherwise they gradually die.

6. One of the first epidemics for which the cause was found occurred in Lausen, Switzerland, in 1872. There had not been a case in this village for sixty years. Suddenly one-sixth of the population came down with typhoid. One family having a private water supply developed no cases. This pointed to the public water supply, a spring which opened at the foot of a ridge, as the probable cause. In a valley one or two miles away, about two months before this outbreak at Lausen, the feces from four typhoid patients had been thrown into a brook. This brook was dammed up to flood the meadows below. With this dam-

ming an increase of water was noticed in the spring on the other side of the mountain. By dumping almost a ton of salt into the brook, speedily its taste was evident in the spring water, although a large amount of flour dumped into the brook had failed to show any traces at the spring. This proved the source of Lausen's typhoid epidemic. The water must have passed through a coarse filtering material in its passage through the mountains. Outbreaks in the foothill towns of Colorado have been traced to infected feces which were thrown on the snow beside a mountain stream and carried down with the melting snows to the towns below. There are few cities or towns which have not suffered typhoid epidemic from their own or their neighbor's contamination of their water supply. Private supplies, as well as public, may be contaminated.

Precautions: 1. Disinfect all feces and urine before they enter a public or a private sewerage system.

2. Do not tolerate flies. Food may be contaminated by them, although they have been removed from it. Start or join a campaign to abolish their breeding places.

3. Do not take one who has ever had typhoid into your house as a member of the family or servant without making sure that that person is not a carrier. At least one railroad system in the United States examines the health of its dining car waiters. This should be universal in all public eating concerns, as well as in bakeries, dairies, and candy, grocery, and meat shops.

4. Disinfect all clothing or cloths before they are washed with other clothing or put into a hamper.

Diarrhea

There are probably many different germs that cause diseases of this kind—dysentery, cholera

infantum, and inflammation of the bowels. Babies, in hot weather especially are likely to suffer from these diseases. Statistics show that almost three times as many babies died in the United States during the years 1903 to 1907 from these diseases as there were soldiers died in action or were fatally wounded during the Civil War.

The germs leave the body in the feces.

They enter: 1. In contaminated food, milk, and water.

2. Through the mouth by improper use of dirty hands.

Precautions: 1. Disinfect both feces and urine immediately, as in typhoid. Also disinfect all clothing and cloths.

2. At all times wash fruit and vegetables very thoroughly, particularly if they are to be eaten raw. If possible, hold them under a strong stream of water after they seem clean. If a stream of water cannot be had, use several different waters in abundance.

3. Milk, particularly that which is used for babies or children, should be clean and kept in sterilized, covered vessels at 50° F. or below. Milk which produces no ill effects in older children may cause death in babies when their bodies are weakened by excessive heat.

Boils, Carbuncles, Abscesses

These and pimples, acute inflammation of the bones, breaks in the skin in which pus has gathered, blood poisoning, and erysipelas belong in the same class. The germs leave and enter the body by way of the skin or through a break in it. A cut, scratch, burn, or bruise offers an opening or a weak spot.

Rubbing carbuncle germs on the unbruised whole skin of the forearm produced seventeen of these. The germs entered through the sweat glands and hair follicles.

Resistance: There are two kinds of germs causing these diseases. The one causing boils, abscesses, carbuncles, inflammation of the bone marrow, and sometimes other cases of inflammation, is one of the hardest of the non-spore-forming bacteria to kill. Not only is this true, but the dead bacteria can still produce their diseases with a poison or toxin which is found in their cells. The other kind of germ is found either by itself or in company with this in the other diseases mentioned. It is not so hard to kill, nor is the poison in dead bacteria so strong. With either of these germs, those which are transferred directly from man to man produce much more serious results than do the same kinds of germs which enter the body after living upon the skin or mucous membrane for a while.

Precautions: There is a tradition that a siege of boils frees the blood from impurities. There is no more reason in this than there would be if that were said of pneumonia or tuberculosis. A series of boils means that germs causing these have made their way through the skin in several spots. The first boil was probably carelessly managed and germs were rubbed into the skin in all of the other spots where boils appeared.

1. The cotton and other wrappings of boils, abscesses, etc., should be burned immediately, and no soiled wrapping should have its surface exposed to contaminate other objects with which it comes in contact.

2. If a salve or disinfectant is applied, it should be upon cotton. Fingers should never touch a sore of any kind. If

an instrument is used for lancing, it should be sterilized before and after using.

3. When a red spot likely to develop into a pimple is first noticed, swab it with cotton wet with hydrogen peroxide; do not let it come to a head and then open it and give it a chance to cause further infection.

Tetanus or Lockjaw and Blood Poisoning

These diseases follow most frequently Fourth of July accidents and the puncturing of the skin by pitchforks, old nails, or pins. The germs of tetanus are likely to be found in horse manure and soil. They have been found on wads of blank cartridges made in Germany. These germs grow, it is believed, only in the body, and then only under certain conditions. They flourish in deep wounds where there is no air, and then more likely when much dirt has been forced into the cut. The bacteria remain on the spot where they are first placed in the body, but the poison which they produce as they grow travels along certain nerves and produces the muscular symptoms of lockjaw. The discovery and use of antitoxin before the symptoms were developed reduced the number of deaths from this disease after Fourth of July accidents from 406 deaths out of 4,449 accidents in 1903; to 62 deaths out of 4,413 accidents in 1907.

There is no hope of success with the antitoxin after the symptoms have lasted for thirty hours.

Resistance: 1. The germs survive boiling for one hour. 2. Cloths or other articles may carry spores of these germs which will produce the disease for years after they have been first infected.

Blood Poisoning

Any break in the skin, no matter how slight, allows the possibility of blood poisoning. The germs causing this may be on the skin itself, on the articles causing the injury, on the bandage, or any other surface coming in contact with the exposed flesh. No pin scratch is too small to be free from danger. Many deaths from blood poisoning have been due to carelessness in this respect.

Resistance: These bacteria are not so hard to kill as those of boils and carbuncles.

Precautions.—Care of deep wounds: 1. Clean these by squeezing, if necessary, to force the blood out of the wound and use it as a wash to carry out any dirt or germs. A disinfectant may be carried deeper into the wound by the use of a medicine dropper.

2. If something has broken off in the wound, it should be taken out. If it is not so deep as to need a doctor's skill and instruments, use a strong needle, sterilized in a flame or in a disinfectant. After these two things have been properly done, the care of the wound is the same as that of a surface wound.

Care of surface wounds: 1. Wash the wound, thoroughly with cloth or cotton wet in an antiseptic or disinfectant solution. Put a piece of sterile bandaging or sterile cotton on the wound and then a bandage. If wounds have

pus in them, it means that they have been dirty, not necessarily with visible dirt, but with bacteria. A clean wound forms a brown scab or skin and soon this is loosened by the formation of new real skin underneath it.

Meningitis

The germs leave the patient, convalescent or carrier, who appears healthy:

1. Through the secretions of the nose.

They enter through the nose, carried by:

a. Direct contact.

b. Handkerchiefs, hands, towels, cups, and droplets.

Carriers are the chief sources of the disease.

Sore Eyes

Pink eye is a common disease among school children. A more severe form of sore eyes is called trachoma. Immigrants are examined for this at all ports and sent back if they are found to have it.

The germs are carried by handkerchiefs, hands, towels, wash basins, etc.

Precautions: 1. Cover the infected eye or eyes with a cloth.

2. Burn the cloth when it must be discarded.
3. Do not use the family basin for washing the eyes.
4. If you have well eyes, do not rub them.

Ringworm

This eruption on the skin is due to an infection by a kind of mold. As the first mold plants develop ripe seed, they drop these around themselves in a circle and then are ready to die. Thus, the center

of the sore heals and the infection spreads in rings. What precautions are necessary to prevent the spread of this over the body or to other bodies?

HYDROPHOBIA

The germs of this disease, contrary to what is generally believed, may be found in dogs and cats at any time of the year. The hot, dry days of August do not cause madness, only the presence of these germs. The mad animals crave water, but they cannot drink. They have a thick, stringy saliva, and usually a cough or a bark. A bite or scratch from an infected animal will transfer the disease to the human body. The symptoms do not occur in less than two weeks and sometimes not for a year. The saliva contains the germs. The best thing to do if there is the slightest doubt as to whether the animal is mad or not is to confine it to see if the disease develops. Then the course of treatment is certain. Hydrophobia is always fatal with dogs. Recovery means that it was not mad.

If one is scratched or bitten, the wound should be washed by a physician with a disinfectant after it has been washed at home with one of the household disinfectants. If it should develop that the animal had hydrophobia, the Pasteur treatment should be applied with all speed. Laboratories for the preparation of the cure are situated in New York, Chicago, and Baltimore. The cure may be given at the

patient's home if the material may be used within thirty-six hours after it has left the laboratory. All the lower animals may have hydrophobia, but trouble comes more frequently from dogs. To prevent the disease, dogs should be muzzled all the year. Although this is distressing to lovers of dogs, the following table shows the results of muzzling:

NUMBER OF DEATHS FROM HYDROPHOBIA IN ENGLAND AND WALES FOR A PERIOD OF TWENTY YEARS

No Muzzling		*Muzzling Enforced*		*Muzzling*	
1887	29 deaths	1890	8 deaths	1900	0 deaths
1888	14 "	1891	7 "	1901	0 "
1889	30 "	1892	6 "	1902	2 "
1893	4 "	1896	8 "	1903	0 "
1894	13 "	1897	6 "	1904	0 "
1895	20 "	1898	2 "	1905	0 "
		1899	0 "		

SMALLPOX

This disease was once a dreadful scourge. In the latter part of the 18th century in England one-third of the population showed scars. The first step towards its prevention was the discovery that milk maids who had become infected with cowpox either did not contract smallpox, or had light cases. This led to the process of vaccination, which Sir Edward Jenner used successfully in 1796. The practice of vaccination soon spread throughout the civilized

world. The effect of compulsory vaccination in Sweden, where accurate records have been kept since 1774, is shown by the following data:

1. With no vaccination from 1774 to 1801, average mortality per million, 2,045.
2. Optional vaccination from 1802 to 1816, average mortality per million, 480.
3. Obligatory vaccination from 1817 to 1893, average mortality per million, 155.
4. More stringent regulation of vaccination from 1893 to 1902, not greater than 5, and one year only .2.

In 1899 in 285 German towns, with a population of 16 million, where vaccination was universal, the deaths from smallpox were 4.

In the same year in 116 towns of France, with a population of 8½ million, where vaccination was not universal, the number of deaths from smallpox was 600.

Porto Rico, before the Spanish war, had an annual mortality from smallpox of 600. Since the United States has instituted general vaccination, it has been reduced to virtually none.

When vaccination is accompanied by disturbance in other parts of the body or with serious inflammation at the point of vaccination, the fault lies not in the principle of vaccination, but in carelessness. This opening of the skin is liable to infection just as any wound is, and must be kept clean and covered, and be made with pure vaccine.

Rheumatism

This is a new disease to be placed in the infectious list. At present no more can be said than that the affections of the muscles, bones, and nerves, called

rheumatism, neuralgia, neuritis, and arthritis, are now believed to be due to bacteria. Work is being done to isolate the germs and discover a cure.

Mosquito-Carried Diseases

Malaria, until recent years, was thought to be due to damp night air. Now it is known to be due to the presence of a parasite in the body. This is carried from person to person only by a certain kind of mosquito in the blood which it sucks from and injects into people. At night mosquitoes are most active. That, alone, is the connection between night air and malaria.

Prevention: This lies in abolishing all breeding places for mosquitoes; in draining swamps, in filling puddles, covering the water in rain barrels with kerosene, cleaning gutters, and in thinning shrubbery so that it offers no damp spot for breeding. People living in a malarial country, through the use of screens and mosquito netting, have kept themselves free from the disease. Another important measure for prevention of the spread of malaria is the screening of patients from mosquitoes to prevent infection by these pests. The careful practice of these two measures would go far toward bringing about the extermination of malaria in a few years.

Yellow Fever. Another kind of mosquito carries the parasite of yellow fever. The same precautions would soon stamp out this scourge of the tropics. The universal application of these precautions

would exterminate all mosquitoes, whether disease-carrying or not.

REFERENCES. "General Bacteriology," Jordan. "Primer of Sanitation," Ritchie. "Emergencies," Gulick. "Practical Hygiene," Harrington. "Preventable Diseases," Woods Hutchinson.

CHAPTER XXXII

THE SITUATION OF THE HOUSE

Of all the conditions which affect the vigor of the body, the situation of the home is, perhaps, the most important. This includes:

1. The possibility of having sun and air in the house; of having light in all the rooms and, above all, windows on the side of the house which will let the prevailing winds into the bedrooms at night. If the latter cannot be accomplished directly, it may be possible through other windows which need not be locked for safety.

2. An environment free from odors or noisy industries; free from breeding places for flies and mosquitoes; *i. e.*, standing water, swampy spots, manure piles, open privies, and uncovered garbage. Flies travel, it is thought, within a radius of not more than a half mile of their breeding places.

3. The cellar or basement should have light and possibility for a draught through it. It should be dry and never subject to the backing up of water in the drains. In order to have pleasant air in the house the cellar must be in good condition. It is a good plan to whitewash the walls to make dirt easily noticeable, and whitewash is a disinfectant.

4. Choose, if possible, a situation which affords from at least one window, a view unobstructed by buildings for the length of a city block. This gives great rest to the eyes and spirits.

5. Select a quiet, little traveled street, in preference to a much frequented one. Although one may grow unconscious of noises, yet it has been shown that even the noise made by a person's entering a sleeping room without the least consciousness to the sleeper, increases the rate of his heart beat, thereby disturbing his relaxation and rest.

6. The sewage should be so taken care of that there is no possibility of odor from it.

7. The water supply should be above suspicion. Ask the official in charge of the public supply about it; inquire into the death rate from typhoid fever, which is an index of the purity of the water.

These conditions are permanent and not subject to remedy. They must, therefore, be given the first and greatest attention by the house hunter. The architecture and plan of the house matter but little in comparison with these considerations.

The Construction of the House. This is important in determining the ease with which it may be kept warm in winter and cool in summer. Thick walls with inter-air spaces are very important. This gives quiet or dead air which is, as other gases are, an exceedingly poor conductor of heat. Brick, stone, and cement blocks, made with open spaces in

the center, are good materials. Bricks should be laid so that there are dead air spaces between the tiers. Weather boarded or shingled houses should have building paper and siding under the outer covering. A stucco or cement house should have these on the outside lath also.

The tightness of windows and doors is an important condition of warmth, also of freedom from rattling by the wind. If storm windows are to be used, see that two windows in each room, if possible, have sashes which may be extended at least one foot at the bottom.

CHAPTER XXXIII

INDOOR AIR

Although the house is located so that the outer air meets the requirements of the preceding chapter, there remains to be solved the problem of making indoor air pleasant when artificial heat must be used.

Since the era of open-air sleeping, open-air schools, and open-air treatment for pneumonia and tuberculosis patients began, scientists have tried to discover the reason for the curative and invigorating qualities of out-of-door air. An investigation into this has brought, within the last ten years, a complete revolution of our ideas as to what is pure, unvitiated air.

The changes in the out-of-door air of temperature, movement of wind, and humidity, produce well-known effects upon the physical vigor. The depressing effect of warm, calm, humid air; the relief which a light breeze gives; the invigorating cold days of fall, with their brisk winds, all of these influences were at first neglected in explaining the depressing effects of indoor air.

The now abandoned theories as to what makes impure air must be held in mind as a matter of recent

history because of the firm hold they have upon people even today.

Error Regarding Carbon Dioxide. Since carbon dioxide is given off in breathing, its proportion in the air of a house must be greater than in outdoor air. Outside air contains, normally, 3 parts of carbon dioxide in 10,000 parts of air. Six parts in 10,000 has been set as the limit above which air was considered impure. To supply enough air to maintain this low amount of carbon dioxide, 3,000 cubic feet of fresh air had to be supplied to each individual each hour. These figures entered into building codes and mining regulations, and have been the reason for some mine explosions. It has been discovered, however, that if other conditions are right, no discomfort is felt if even more than 200 parts of carbon dioxide are present in every 10,000 parts of air. Also, that people have worked mentally and physically for more than twelve days with only 212 cubic feet of air per person per hour, and felt no discomfort. It has been shown that in well-ventilated rooms the air inhaled by a person standing or sitting quietly contains from 25 to 36 parts of carbon dioxide in 10,000 parts of air, and in rooms in which the air does not seem very impure there have been found as many as 60 to 70 parts in 10,000. In the air of factories where carbon dioxide is manufactured, from 14 to 93 parts of carbon dioxide were found. The men were engaged in this work

in 12-hour shifts, and some had been so employed for eighteen years without detriment to their health.

Poisons from Breath. When carbon dioxide had to be abandoned as the cause of impure air, its companions were accused. It was thought that poisons were given off with the breath. However, quantities of air exhaled by a large group of people, to the extent of making a room feel stuffy, have been condensed and examined, but as yet this has not been proved to be the cause of depressing effects of bad air.

Humidity and Temperature. The humidity and temperature were next investigated. The high temperature (80 to 85° F.) and high humidity due to water vapor exhaled in the breath and from the burning of gas or kerosene lamps or stoves, together with little or no movement, have been proved to be the cause of the sleepiness, dizziness, headache, and susceptibility to colds from which house dwellers suffer. These account for the frequent sleepiness at lectures and church; for the early evening drowsiness of students shut up in small rooms with a study lamp, for the same feeling when families gather for quiet reading or sewing around the lamp and fireplace with the doors infrequently open. Under such conditions of high temperature and humidity, the movement produced by an electric fan has been found to be a great source of relief.

Still greater relief, however, is given by the cooling of the air. House air under over-crowded conditions, and especially when fuels which give off large quantities of heat and water vapor are used for illuminating purposes, may show high humidity with high temperature. The average American house, however, has the difficulty of high temperature and very low humidity. It has frequently been found to be 15% in schools as well as in dwelling houses.

The average humidity for a year in the United States east of the Missouri River and on the Pacific slope is from 70 to 80%. In Arizona, New Mexico, Colorado, and Nevada, it is less than 50%. In other western states not mentioned before it is from 50 to 60%. This means that the outside air, with an average humidity of from 60 to 80%, when heated, allows more space for water vapor, and has not enough to keep the humidity the same. Throat troubles, headaches, the parched, almost gasping feeling of the mucous membranes of the mouth and lips, distinctly noticeable when heat is first started in the fall—all of these are due largely to the high temperature and low humidity of the house air and the difference between this and out-of-door air. On account of this greater space for water vapor as air is heated, furniture may come apart and plants dry out and die.

In a hot-air furnace near the fire door there is a pan holding about two gallons of water, which

is evaporated slowly, about two quarts per day in very cold weather. This moisture passes into the heated air as it rises into the rooms. An experiment tried in a double house to find the difference in humidity when this pan was kept filled and when it was not, showed a difference of just 1%.

With a furnace made to order, in which there was a capacity for 72 quarts of water, it was found that on cold days, with the thermometer between 20 and 30° F., from 12 to 15 quarts were evaporated, while in severe weather from 20 to 24 quarts had to be evaporated every day to keep the humidity at 35%. It was found impossible to maintain a higher humidity in cold weather without the collection of frost on the windows. It could have been raised higher had the house been provided throughout with storm windows. With these conditions, 68° F. and 35 to 40% humidity, those entering the house remarked upon the balminess and gentle, soft character of the air. The house dwellers found themselves free from the old fidgetiness, parched skin, restless nights, and frequent colds from which they had suffered with the old furnace and low humidity. This is the result of an experiment carried out by Lillian S. Loveland and reported in *Good Housekeeping* for 1911.

A Difficult Problem. When it is found necessary to evaporate this number of quarts of water to even approximate good conditions, it will be seen how useless are the deep, narrow pans hung on the backs

of radiators with their small evaporating surface. Shallower pans of water, set under radiators or in registers, offer more evaporating surface. Water in four registers in addition to that in the furnace pan, increased the humidity of the house in which the above experiment was made only 2.4% by evaporating 6 quarts of water per day. From this it is plain that the heating devices which are now on the market are sadly lacking in furnishing air that is adapted to health and happiness.

Here and there scientists are working out schemes for producing ample humidity with steam and hot water as well as hot air. There is not yet sufficient realization on the part of the public of the effect of dry air to make manufacturers work for such an end. Highly heated, dry air creates great sensitiveness to outdoor air, or even to air of 68° F. and 50% humidity. To satisfy one living in those bad conditions, higher and higher temperatures must be produced. With a low humidity so much water is evaporated from the skin of the body that a high temperature must be had to avoid a chilly feeling; more and more clothing is put on, windows are not opened in daytime and very little at night, open air exercise is shunned, and a good start to bad health is made.

Change of Temperature Good. The temperature to which the normal body is subjected should not be kept constant. The vigor or stimulation of the body is due largely to the play of different sensa-

tions upon the skin. Lack of change in these leaves unstimulated the central nervous system, and the body lapses into a state of, at least, dullness. If changes are made very gradually they fail to stimulate, just as pressure applied gradually to the hand fails to produce the effect which its sudden application would. Clothing should not be worn so thick that it does not allow the skin to feel changes of temperature. The whole surface of the body should be exposed daily to at least an air bath at room temperature, if not below. A cold is not taken by the blowing of a breeze upon the body unless the cooling of the body goes on for so long a time that it becomes thoroughly chilled. Just as one should keep the heart in practice for emergencies demanding speed, so the skin should be kept in training to react in emergencies of cold by being subjected to changes of temperature for short periods. This, of course, does not hold in cases of illness, when the nervous system is so weakened as to be unable to react to changes. When you feel a slight movement of air, even if it is cool, train yourself to endure it for a short time, do not immediately close the window; shiver if you feel like it, that is one of the means the body uses to make heat.

Use of a Thermometer. There should be a thermometer in the living room at least. A difference of a few degrees in temperature, which means discomfort, is not felt until the temperature has had

time to produce the discomfort. Attention to a thermometer, the regulation of the heat supply, and the adjustment of windows will prevent much fatigue and unrest in living or study rooms. Little children, with their delicate nervous systems, suffer much from over-heated houses. Between 63 and 68° F. is warm enough for persons living indoors if proper humidity is maintained. Not until the thermometer reaches a temperature below this, does the body, if sitting quiet, begin shivering to keep itself warm. A temperature below 63° F. produces a chilling and congestion of the blood internally which is likely to be the cause for the development of a cold.

Impure, vitiated air, then, is due to high temperature, too high or too low humidity, and lack of movement. Of course the air should be free from offensive odors, some of which, as from escaping gas, might be harmful; others only unpleasant and therefore indirectly affecting the vigor of the body. To encourage deep, free breathing, which is one of the essentials of good health, the air should be sweet and balmy and have a gentle movement.

What can be done to make house air more nearly perfect with the imperfect heating devices of to-day?

At least keep the temperature down to 68° F. and windows open from the top, but so that no one must sit in a draught. It may be impossible to do this in the living room when the wind is from the direction of its windows. Windows in other rooms may be

kept open, however, and outside air taken in and unobjectionable movement maintained. If a family has been used to a higher temperature, an abrupt change must not be made, but the temperature may be dropped gradually. In case of illness, keep the body of the patient warm by additional clothing, if necessary, but do not increase the temperature of the room. It is exceedingly important that sleeping rooms should have a temperature of not more than 60° F.

Methods of Protecting Against Draughts from Open Windows

1. Lower the window from the top.
2. Raise the window from the bottom and insert a board about three or four inches wide. Close the lower sash down on this. Air may now enter between the sashes at the center.
3. A piece of cloth may be fastened over the open space or a very finely meshed screen used.

References. *House Sanitation,* Marion Talbot. (Contains excellent bibliograph for teachers.) "Stuffy Rooms," *Popular Science Monthly,* Leonard Hill, October, 1912 (teacher).

To Measure Humidity. A very simple process for determining the relative humidity is as follows: For equipment, a brightly polished metal cup (silver is best, and aluminum is next best, but tin will do), a household thermometer, and a few lumps of ice are necessary.

Procedure: 1. Take the temperature of the room.

2. Put water, ice, and the thermometer into the cup.

3. Notice very carefully the outer surface of the cup to see when any moisture is condensed upon it. Rub the fin-

ger over the cup to ascertain this, and note the temperature at which this takes place. The relative humidity means the percentage of water vapor which the air space does contain at any particular temperature as compared with what it could contain at that temperature if saturated.

Suppose the room temperature is 68° F. and the temperature at which dew appears on the cup is 41° F. This means that there is water vapor in the room to saturate the space if the air had a temperature of 41° F. The weight of a cubic foot of aqueous vapor saturated at 41° F. is 2.955 grains. The weight of one cubic foot of aqueous vapor saturated at 68° F. is 7.480 grains. The amount of water vapor at 68° F. is then 2.955 divided by 7.480 as much as it would be if it were saturated. This makes the relative humidity 38%.

THE WEIGHT OF A CUBIC FOOT OF AQUEOUS VAPOR SATURATED AT DIFFERENT TEMPERATURES

Temperature	*Grains*	*Temperature*	*Grains*	*Temperature*	*Grains*
35° F.	2.366	52° F.	4.372	69° F.	7.726
36° F.	2.457	53° F.	4.526	70° F.	7.980
37° F.	2.550	54° F.	4.685	71° F.	8.240
38° F.	2.646	55° F.	4.849	72° F.	8.508
39° F.	2.746	56° F.	5.016	73° F.	8.782
40° F.	2.849	57° F.	5.191	74° F.	9.066
41° F.	2.955	58° F.	4.370	75° F.	9.356
42° F.	3.064	59° F.	5.555	76° F.	9.655
43° F.	3.177	60° F.	5.745	77° F.	9.962
44° F.	3.294	61° F.	5.941	78° F.	10.277
45° F.	3.414	62° F.	6.142	79° F.	10.601
46° F.	3.539	63° F.	6.349	80° F.	10.934
47° F.	3.667	64° F.	6.563	81° F.	11.275
48° F.	3.800	65° F.	6.782	82° F.	11.626
49° F.	3.963	66° F.	7.009	83° F.	11.987
50° F.	4.076	67° F.	7.241	84° F.	12.356
51° F.	4.222	68° F.	7.480		

From U. S. Government Psychrometric tables.

CHAPTER XXXIV

HEATING SYSTEMS

1. **Hot Water.** This is the most satisfactory of all methods of heating in cold climates. As soon as the fire is built in the furnace the water in the pipes which pass over it is warmed and begins to circulate through the house radiators. The radiator does not get so hot as in a steam system; 150 to 165° F. gives a very good heat without parching the air above the radiator. The disadvantages of this system are:

1. It is expensive to install.
2. It allows no method of getting water into the air of the room.
3. A radiator is hard to keep clean.
4. Provides no method of ventilation.

2. **Steam.** To heat by steam more fire is necessary, since the temperature must be high enough to change water to steam before it is sent into the radiators.

The idea of a central heating plant for a group of houses or apartments is very popular now. The objection to this plan has been the waste of heat in carrying the pipes the necessary distances from the heating plant. They are now well wrapped in tarred

wood-pulp and asbestos. This greatly reduces the waste of fuel, the amount of dirt, and the trouble of attendance. It may be expensive to install in houses already built and pavement laid.

3. **Hot-air Furnace.** This is made like a big stove with a metal jacket covering it, with a space of 9 to 12 inches between the two. At some opening in this jacket near the bottom of the furnace air is taken in which is heated by the surface of the stove and passes out through pipes 9 to 15 inches in diameter to the various rooms. Registers should be placed on the unexposed side of the room. This method quickly takes the chill off in early fall and spring days. It has the advantage of causing a circulation of air in the room. Outlet registers are frequently placed near the floor on the side of the room opposite the intakes. The air which has entered the room is warm and is pushed up toward the ceiling, travels across the room, and in so doing is cooled and falls to the floor on the opposite side. A hot-air furnace should be large enough to supply sufficient heat without making the heated air as it comes in the register more than 120° F. The disadvantages of this system are:

1. The difficulty in driving hot air into the room on the windy side of the house.
2. The greater unsteadiness of heat.
3. The inability as furnaces are now made to evaporate enough water to produce the sufficient humidity.

The steam and hot water systems are frequently used as indirect methods of heating, particularly in schools and large stores. Huge fans blow cool air over the heated pipes and force it into the room just as in the hot-air furnace system. A fan in the attic sucks it out. In this case the hot air enters near the ceiling. The used air is taken out through a register almost below this. This system necessitates a careful regulation of windows. They must not be opened while it is working. Frequently it is found that over-crowded rooms are hot and odorous in spite of this forced ventilation and its temperature regulation by means of thermostats.

4. **Stoves.** If stoves are used, they should be of such size that they need not be made red hot to keep the room warm. They make a great deal of dirt and trouble, and they furnish little aid to ventilation. In some cases they are cheerful.

5. **Fireplaces and Grates.** In many climates grates and fireplaces are chief means of heating. They heat mainly by radiation, which is a very extravagant method. Little heat from them is conveyed to the air of the room, as may be shown by putting a thermometer in front of the fire and covering its bulb with some white material to protect it from radiation. Every one has had the experience of roasting the face, and at the same time freezing the back, before a fireplace. They are excellent means of

ventilating a room. Even while not in use, if a lighted candle or piece of burning paper is held in the throat of the chimney, an upward draft will be noticed when the difference in temperature between indoor and outdoor air is several degrees. A grate or fireplace fire is very suggestive of cheer and comfort. If the ashes can be dropped into a pit in the cellar, the dirt and trouble incident to them is greatly decreased.

CHAPTER XXXV

LIGHTING

This subject must be considered from the points of view of eye-comfort and effect on the air.

Modifying Sunlight. Eye-comfort demands a steady light with no glare, with no direct light in the eyes, and with no exceeding brightness. To conform to these requirements the blinds must be adjustable and the face turned either away from the windows or at right angles to them, when the light is strong. A glare from sunlight on a light-colored surface may be effectively broken by thin cotton curtains. Many persons whose eyes are not sensitive to these conditions fail to appreciate the effects of strong light on those whose eyes are more sensitive.

Indirect. Diffused daylight is best for the eyes. As a substitute for this, the indirect electric light is excellent. It must be used with a ceiling of light color; walls of light color add to efficiency, although darker ones may be used. By this means the light itself is not to be seen, and an impression of softened sunlight is given. Fortunately, indirect fixtures are not more expensive than direct fixtures. If reading and sewing are to be done with this indirect light, a

tungsten bulb sufficiently powerful to obviate eye-strain should be used. If so strong an illumination is needed in only one spot, a smaller tungsten may be used and some sort of well-shaded drop-light used for the close work. This is less expensive and at the same time produces more direct light upon the work.

If this device for shading is not possible, frosted electric bulbs or frosted globes on gas should be used, and the lights so placed that they are not in the direct line of vision. Fixtures over dining tables are often of just the right height to carry the light directly into the eyes.

Light and Air. The effect on the air of the room produced by different kinds of lights is shown by the following table:

	Quantity consumed	*Candle power*	*Moisture produced*	*Heat produced, Calories*
Tallow candles	$\frac{3}{10}$ lb.	16	8.2 cu. ft.	1400
Sperm candles	$\frac{1}{4}$ lb.	16	6.5 cu. ft.	1137
Kerosene oil lamp.....	$\frac{1}{8}$ lb.	16	3.3 cu. ft.	1030
Welsbach burner.......	$3\frac{5}{10}$ cu. ft.	50	4.7 cu. ft.	763
Batwing burner, gas...	$5\frac{5}{10}$ cu. ft.	16	7.3 cu. ft.	1194
Incandescent electric light	$\frac{3}{10}$ lb. coal	16	....	37

Adapted from Notter and Firth, *Treatise on Hygiene*, p. 141.

This shows what additional requirements of the ventilating system are made by artificial lights for the regulation of heat and moisture.

CHAPTER XXXVI

FIRE PREVENTION IN THE HOME

Tens of thousands of homes in this country suffer fire losses each year. Three-quarters of these fires could easily be prevented if the occupants had knowledge of the causes of fires and exercised proper care. In this chapter we shall describe the important and simple precautions which every household should take to guard against fire.

Dangers in the Basement. Cleanliness is the best fire preventive. If there is little fuel for a fire it will not spread rapidly. Therefore, keep basements spick and span, and do not store papers, excelsior, empty boxes, barrels and crates, broken furniture, or other combustible and valueless material there. Burn them up. In any event, get rid of packing material immediately, and store in an orderly manner, as far as possible from the furnace and from the stairs, those things that must be kept. People frequently drop matches carelessly in going up or down stairs.

See that ashes are kept out of wooden boxes and barrels, and out of baskets. You may think that ashes are cold or wet, and therefore safe, but the facts are that they are generally dangerous. Keep

them in metal receptacles or store them on a cement floor. Never mix paper or other burnable things with ashes.

The furnace smoke-pipe must be free from rust holes or open joints, and if it is nearer than 12 inches from woodwork of any kind, the woodwork should be protected by using $\frac{1}{8}$ to $\frac{1}{4}$ inch sheet asbestos and then nailing sheet metal over this. Sometimes, especially when starting a fire, smoke-pipes become exceedingly hot. As soon as cold weather begins fire departments expect overheated furnace fire calls, and they are seldom disappointed.

Experience has shown that wood which is charred ignites at a very low temperature. Even steam pipes are frequent causes of fires because they gradually char the wood so that it ignites easily.

The Cook Stove. Coal- and wood-burning stoves are the causes of many fires. Never have them less than 6 inches from a plastered wall, and not less than 12 inches from a wooden surface. Bright sheet metal set about 3 inches from the wall helps to deflect the heat.

To protect the floor against hot coals and ashes, as well as from fat boiling over, sheet metal is needed. It should extend from the back wall, under

NOTE. This chapter is contributed by H. Walter Forster, M. E., Consulting Engineer.

the stove, at least 12 inches in front, and an equal distance on the sides.

A stove on legs is much safer than a range resting flat on the floor. Such a range really needs a concrete floor under it to be entirely safe.

Treat the stovepipe as you would that for the furnace. Where stovepipes pass through floors or partitions, the metal thimbles should provide at least 3 inches of air space.

Never hang dish towels on a line over a stove where they can fall onto the stove if the line breaks.

Gas stoves are less dangerous than coal or wood stoves. If the gas plate type is used, see that sheet metal is under the stove, and asbestos in addition, where the legs are short. Rubber tubes are always dangerous. Have a permanent iron pipe connection.

Fireplaces. Keep the hearth well swept up, do not build too large and hot a fire, and always place a screen in front of the fireplace when you leave the room. It is best to leave it in position whenever a fire is burning. Small children are frequently burned to death by toddling into fireplaces, or by playing with brands which they have ignited at the flames.

Matches. The American nation uses as many matches as all of the rest of the world put together. Most of the matches used are of the dangerous "parlor" kind, which experience has shown to be hazardous for the following principal reasons:

1. Children play with them in spite of instructions to the contrary.

2. Heads fly into curtains, draperies, clothing, and other inflammable material.

3. Heads ignite if stepped upon, this being especially dangerous in the case of women wearing thin house dresses.

4. Heads and sticks glow for an appreciable length of time after the flame is extinguished. Forty-five seconds is about the average.

The safety match, which strikes upon the box, is far safer than the snap match or even the tip match, which has been more recently introduced. If a child gets hold of a single safety match he cannot light it; the heads seldom fly, because it is not necessary to strike the matches vigorously; stepping upon a safety match will seldom ignite it, and the heads do not glow for any appreciable length of time.

Occasionally an entire box of safety matches may be ignited by pushing the slide out of the case with the heads first. Always open a box with sticks out first, and when placing these boxes on brackets or holders, see that the heads are inside, so that they will not all be ignited when one match is carelessly struck.

The modern gas lighter makes matches almost unnecessary where gas stoves and gas lights are used. Its use is strongly recommended.

Illuminating Gas. Illuminating gas has certain inherent hazards, owing to the fact that it is com-

bustible, explosive when mixed with the right amount of air, and exceedingly poisonous to life.

1. Of the vital hazard connected with looking for a gas leak with a match, particularly in a basement, most people are now informed. If you smell gas, open all windows, close all cocks, look for the leak with soapsuds, and, if you value your life, do not strike a light of any kind. Promptly upon discovering a leak telephone to the gas company, which will come at once and investigate the matter.

2. Any form of connection which can work loose, be accidentally pulled loose, broken by a child or by a playful dog is dangerous. This means, in other words, that various types of rubber tubing for cooking stoves, small portable heaters, pressing irons, and table lamps are dangerous. Have everything connected up with pipe where possible, and if a tube is used have secure fastenings at both ends and have only one shut-off cock, and this at the pipe end, so that there will be no gas pressure in the tube when it is turned off.

Gas cocks must have stops so that you may be certain that they are turned off.

3. Remember that when a flame is turned very low, as on a kitchen stove, the opening of a door is likely to blow it out. If you come back into the kitchen and find a strong smell of gas, ventilate everything well before lighting the gas again.

4. The coin meters, which require a quarter to be

placed in them ever so often, have caused the loss of lives because the meter stopped delivering gas while a number of jets were open. Then when more money was put into the meter, the jets not being all closed first, gas issued from these outlets and caused explosions or asphyxiations.

5. Woodwork, curtains, clothing, and hair are often ignited by unprotected gas jets. Do not use swinging brackets where the flame can ignite woodwork. Even plaster partitions may be heated enough to ignite laths back of plaster. Have the plumber put on a rigid bracket, or limit the swing by means of stops.

6. Never use a gas fixture within curtain-blowing distance of a window. Put globes on lights, and be careful in going near them.

Electric Wiring. When the causes of fires are not known there is a decided tendency to blame them upon defective electric wiring. The dangers of ordinary house lighting system are not nearly as great as most people believe, and if the following points are borne in mind the danger of fire from this source and the possibility of serious shock will be largely overcome.

It takes training and experience to be a competent electrician. Do not try to put in electrical work of any kind which has to do with lighting or power circuits. Bell wiring supplied with energy from a few batteries is quite a different proposition from

light wiring which has a large power house behind it. If anything goes wrong, except possibly the blowing of a fuse, call in a competent electrician.

1. Keep incandescent lamps away from shelves, clothing, linen, and other materials stored in closets, and never put tissue paper or cloth or any other combustible material in direct contact with the lamp bulbs. Over three-quarters of the electric current for which you pay is used up in the generation of heat, and the balance for giving light. Wrapping an incandescent bulb in a blanket, for example, and taking it to bed to help keep warm, will almost invariably start a fire within a short time.

2. To all incandescent lights attached to cords, so that they can be moved, it is well to fasten a wire guard to prevent direct contact of the lamp with combustible material.

3. Extension cords should be replaced by new ones, if seriously frayed, and especially if cracked or otherwise defective so that the copper shows.

4. Fuses are intended to melt and prevent further flow of current in event of over-loading of circuit, or in event of short-circuit taking place. The blowing of a fuse usually means trouble of some kind, and if there is any question as to what the source of this trouble has been, do not attempt to replace the fuses yourself. If starting the vacuum cleaner or attaching an electric iron blows a fuse, disconnect the device and make sure that the circuit is large

enough to supply the necessary current before connecting again. If trouble has occurred in a fixture, this must be repaired before a new fuse can be put into position. Never replace a fuse until the main switch is open, otherwise you may be seriously burned.

5. If an electric storm is near, keep away from lighting fixtures. They may be charged and cause injury.

Shocks and burns occasionally result from using an electric iron in a basement with a cement floor, especially if the iron is defective or the floor damp. It is best to stand on a dry board or on a dry rug or piece of carpet.

If any member of the household gets a shock from a switch, lamp socket, pressing iron, or any other part of the electrical equipment, call in an electrician. Sometimes a transformer (an electric device for reducing the electric pressure) breaks down and charges the house lighting system with a deadly current. It does not pay to take chances or to investigate matters of this kind which you do not understand thoroughly.

6. Finally, never touch a lamp socket or any other metal lighting fixture while the other hand or any part of the body is in contact with steam piping, radiators, plumbing fixtures, or any other metal which is connected with the ground. Be particularly careful when you are in a bath tub containing water.

The water, of course, is in contact with the soil pipe, and this goes directly into the ground. A disagreeable shock may result, and occasionally people have been killed by voltages (electric pressure) as low as those used in house lighting.

Kerosene Lamps. The following cautions regarding the use of kerosene lamps are well worthy of observance:

1. Where there are children or playful dogs in the house, do not have lamp resting on a tablecloth, by means of which the lamp can be pulled to the floor.

2. Be very certain that the grocer furnishes you with kerosene of the standard flash point. This is about 120° F.

Kerosene of the cheaper varieties gives off inflammable vapors at a temperature as low as 90° F. This means that when the oil is at that temperature, with that flash point, an explosion of the vapors would occur, and if the lamp should be broken the oil would burn freely itself and set fire to anything it touched. In some states no oil is allowed to be sold with the flash point lower than 140° F.

Not long ago a grocer in a New England town was the cause of a number of explosions and fires, because, as it later turned out, he had filled kerosene cans from his gasolene barrel, confusion resulting because barrels were close together in his dark basement.

3. Lamps which have metal bowls for holding the oil are far safer than those with bowls of glass.

4. Never fill a lamp when it is burning. The greatest hazard attends such an act.

5. Keep lamps clean, fill the bowl frequently, so that the oil is preferably never below the one-half full line, and keep the wicks long, full width, and clean.

6. In blowing out a lamp, turn it down first, so as to reduce the possibility of the flame being blown into the bowl, and then blow across the top of the chimney. It must be remembered that the bowl contains an oil gas, and if this should be mixed with air in the proper proportions, blowing even a small amount of fire into the bowl may cause a serious explosion. This is one reason why the wick should fit the opening very snugly.

Acetylene. This remarkable gas, made by bringing calcium carbide and water together, is extensively used for lighting dwellings, particularly in the country, where there is no illuminating gas or electric current supply available.

Acetylene light is remarkably white, enables colors to be matched readily, has properties which enable plants to grow in it, and is not nearly so poisonous as ordinary illuminating gas.

As used with a piping system similar to that for city gas, acetylene is safer, because the flame is smaller, the burners are designed so that the flame cannot be turned down without seriously affecting the light, and not enough gas can issue from the one or two jets in the course of a night to overcome a person in ordinary health.

1. Acetylene gas is the most violently explosive of all commonly used gases, and because of this the acetylene generators should not be located in basements of dwelling houses particularly they should not be placed near the furnace. The only safe place for a generator is outside of a building in which persons live. Generators are frequently placed in

small, special buildings thirty or more feet away from other buildings of importance.

2. If placed in the basement, there should be a tight partition between the generator and the furnace room; under no consideration should any form of flame ever be brought near the generator. This section of the basement should be well ventilated. It must, however, be kept warm enough to keep the water in the generator from freezing. If anything goes wrong with it, call in an experienced plumber, and be very careful that he also observes the rule of keeping fire away from the machine.

Gasolene. The hazard of gasolene is exceedingly great. Not only does it cause thousands of fires each year, but many people are burned to death by using it.

1. The gasolene stove is ultra-hazardous, partly because gasolene has to be handled in filling it. Filling a stove which is burning invites death. If the tank cannot be detached, put out the fire before filling the tank; if it can, take the tank outside of the house to fill it.

2. Keep the gasolene supply in a tight can and outside of the building. Never keep it where vapor can be ignited by stoves, furnaces, gas jets, or by carelessly discarded matches.

3. Use a blue flame kerosene stove instead of a gasolene one. The results are good and the danger much less.

4. Most people have noticed that sparking results from rubbing a cat's fur in cold weather, or from dragging the feet across a carpet and then touching a gas fixture. Static electricity is produced by rubbing. When a woman cleans silk or woolen clothing or gloves in gasolene, similar sparks may be produced, fire result, and death follow. Many

women are burned to death each year by this cause, and few understand why such fires occur.

5. Gasolene is so dangerous, even in the hands of experienced persons, that it has no place in the home. Never use it if you value your life.

Polishes. Stove polishes and liquid metal polishes frequently contain benzine or naphtha, both of which are equally dangerous from a fire standpoint. Insist on a noncombustible polish. You can easily make a test by putting a small amount of polish on a cloth and setting fire to this at some point where no danger can result.

If you do use a combustible polish, never do so in the presence of a flame of any kind.

Spontaneous Combustion. The theory of spontaneous combustion is rather difficult to understand. How a piece of wiping cloth dampened with furniture polish can catch fire by itself is not, as a rule, clear. It is, however, a well-established fact that many a householder has learned to his sorrow. Linseed oil is most dangerous, and all other vegetable and animal oils are more or less dangerous. Among the better known oils are hemp, nut, cottonseed, rape, castor, and olive. Olive oil, the least dangerous of this number, is about half as subject to spontaneous combustion as linseed oil. There are cases on record where butter, on becoming rancid, has heated to the point of igniting cotton in which it was wrapped. The heating results from a chemical

combination of oxygen in the air with oil. If the fabric is not too oily, if the quantity is moderately large, and if it is fairly compact, the rise in temperature may be decidedly rapid. A wiping-cloth used on wooden floors or furniture is almost ideal for self-ignition. Sometimes only three or four hours elapse from the beginning of the process until the fire breaks out.

All rags which have been used should be burned at once. It is best not to take chances. If they are kept for another time they should be placed in a stone crock with a cover, and preferably on a cement floor, where fire can do no damage.

CHAPTER XXXVII

PLUMBING

Great fear used to exist that what was called "sewer gas" would get back into the houses from the sewers. Tales were abroad only fifteen years ago telling of this as an odorless gas sneaking into the house, carrying disease with it. It was thought that germs were carried back. An investigation shows the health of men working in the sewers to be at least average. Analyses of sewer air show it to be freer from germs than street air. A properly constructed and operated sewerage system carries off the waste without its lodging in an angle or other spot out of the path of a generous supply of water. The first plumbing contrivances with their complicated schemes for keeping out the so-called "sewer gas" offered many places, difficult to get at and clean, for the lodging of particles of sewage. These schemes, then, defeated their own purpose and created (by the decomposition of the sewage in their crevices) a sewer air which was at least unpleasant to have in the house. With simple contrivances and open plumbing, no one objects to having a plumbing fixture in a bedroom. It is wholly without odor unless mistreated by a careless house-

keeper. The following drawing illustrates a cross-section of the house with the various fixtures and their attachments.

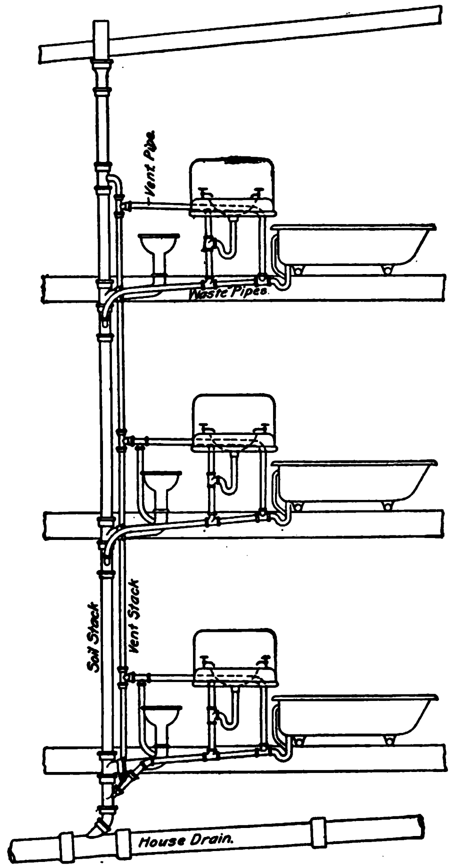


Fig. 7.—Cross section of house showing arrangement of plumbing. Two pipe system, main vent pipe, also vent pipes from individual fixtures.

In the one-pipe system the main vent is kept, but there are no small vent pipes except from the closet

fixtures, and from these only when there is more than one such fixture in the house. This saves about one-half the cost of piping and makes necessary much less cutting of walls and floors. It is perhaps cleaner than the two-pipe system. The only objection may be a slight gurgling noise in the traps when a flush is made.

From *Principles and Practice of Plumbing.* Cosgrove.

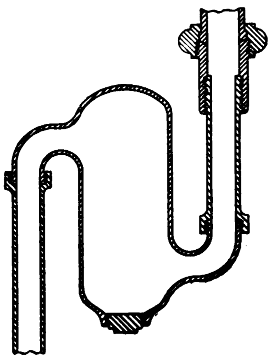


FIG. 8.—A non-siphoning form of trap which is said to cleanse itself by the whirling motion of the water as it passes through it.

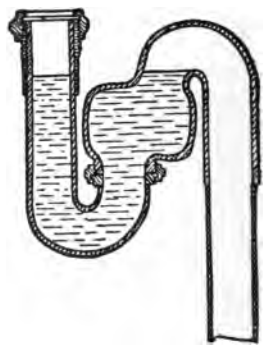


FIG. 9.—Example of a non-siphoning trap.

1. *Soil pipe.* An iron pipe five inches in diameter passing without a bend from above the roof to the beginning of a horizontal sloping pipe, the house drain carrying house sewage to the street sewer.

2. *Waste pipes.* Iron pipes 1½ to 2 inches in diameter, carrying sewage from all fixtures, except closets, into the soil pipe.

3. *Traps.* In closet fixtures these are made of earthenware; in all other fixtures, of iron. They retain some water

known as a seal to prevent the passing back into the house of any possible odor.

4. *Vent pipes.* Formerly considered necessary to provide a system for the circulation of air in the house plumbing and to prevent the breaking of the water seal by suction of other fixtures or by air pressure and then suction from the main sewer. Venting is now discarded when non-syphoning traps are used. All of the vent pipes are more or less dirt catchers and impossible to clean. They also

Courtesy Standard Sanitary Co.

Plate 31.—Shows mixer faucets and cocks which may be quickly turned without the use of the hand, to prevent soiling.

Courtesy Standard Sanitary Co.

Plate 32.—For hospitals, showing use of feet instead of hands for turning on water and for adjusting the waste plug to release the water.

double the cost of piping. The opening in the soil pipe above the roof opens an outlet for any sewer air which may get into the house system.

5. *Flush tank.* The box which contains water to wash the closet fixture.

In an examination of vent pipes from twenty-three kitchen sink traps, twelve were completely obstructed with grease, ten partially obstructed, and only one perfectly

clean. This had been regularly inspected and cleaned. This teaches the following lesson: Buy non-syphoning traps and avoid these dirt catchers.

Placing of Fixtures

1. Set the bath tubs either flush against the walls or wall and floor, or so far away from them that the space left between may be easily cleaned.

Courtesy Standard Sanitary Co.

Plate 33.—The flush box is a galvanized iron tank behind the wall. The water from it is released by a spring in the seat. This makes fewer chances for infection than a push button or chain.

2. Set the kitchen sink so that the bottom of it is about the same distance from the floor as the palm of the hand. As sinks are placed now, they are too low for even very short people. A height of 31 inches from the floor to the bottom of the sink is a good average height. If a sink has non-adjustable legs, it may be raised by setting pieces of galvanized iron pipe under its legs if it is not a wall sink.

3. Use the same principle in regard to height in setting basins.

4. Have a flush tank at least six feet above the closet fixture except when a Sanitas or Syphon-Jet closet is used. If the bottom of the tank is on a level with the closet seat, there is not sufficient force to the water flow to wash down material always with one

or even two flushings. In the closets mentioned, a jet of water enters the bowl so as to force all the material down. At least four gallons should be allowed for each flush.

5. The burdensome pail under the refrigerator drain may

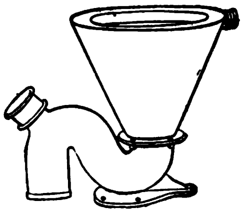


Fig. 10.—A closet offering much surface for soiling.

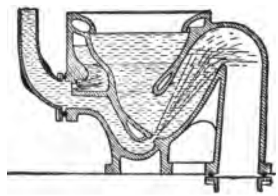


Fig. 11.—Offers little surface for soiling. Jet of water drives material down soil pipe.

be abandoned. If the refrigerator is built in, a pipe may be firmly attached to the end of the refrigerator pipe through which the water may be carried to some dripping spot. If it is not built in, a cement platform may be made

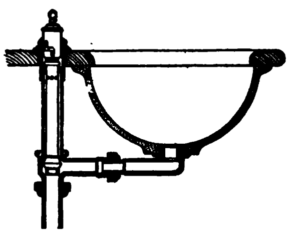


Fig. 12.—This allows no way of cleaning the pipe from the plug to the opening in the basin.

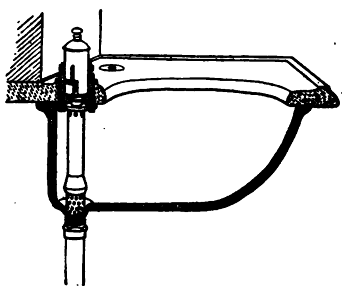


Fig. 13.—A better position for outlet in bowl.

for the refrigerator to stand on, and a depression made in the center fitted with perforated metal opening from which a pipe leads to the dripping spot. The place of outlet of this drain is of great importance. The pipe may be allowed

to drip over a small trapped sink over which there is a faucet in the basement or over a laundry tub or the cellar drain. This pipe should be flushed out with very hot water once a week to insure its remaining clean.

Choosing of Fixtures

1. *Sinks* should be made of enameled iron, with back, dripboard, and trough in one piece. There should be perforated openings into the waste pipe, made of the same material, not of nickel or brass. Tap handles should be made so that they may be turned without using the fingers, and need not be held open.

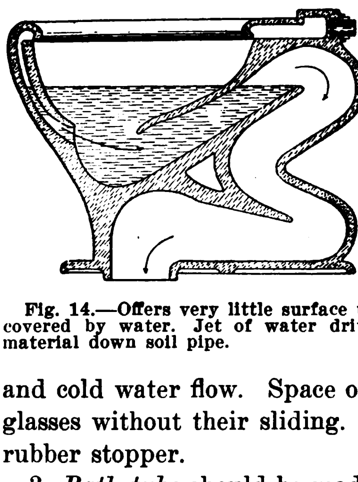


Fig. 14.—Offers very little surface uncovered by water. Jet of water drives material down soil pipe.

2. *Basins.* Porcelain bowl and sides of one piece. Around faucets no narrow groove difficult to clean. Mixer faucet, one out of which both hot and cold water flow. Space on the sides of the bowl to set glasses without their sliding. A waste plug rather than a rubber stopper.

3. *Bath tubs* should be made of enameled iron or porcelain, and be provided with a waste plug and a mixer faucet.

4. *The closet* should offer the least surface subject to soiling and should have a strong jet of water forcing material down the soil pipe.

Keeping Fixtures Clean

1. *Closets.* Hydrochloric acid may be used as a disinfectant and remover of stain from hard water, since it does

not injure earthenware, of which the bowl and the trap are made.

2. *Sinks and Basins.* Lye should be used to clean the traps of these, since it does not injure metals of which these traps are made, as acid does. A fine washing or scouring powder cleans porcelain or enameled iron satisfactorily. Lye should not be allowed to rest on the enamel. To avoid clogging traps, matches, hair, threads, stiff paper, cloth, withered flowers, large pieces of fruit peelings, etc., should not be allowed to pass into the traps. If water runs out of the basin or sink a little slowly, use lye solution. If this does not clear it, unscrew the nut which is fastened to the downward curve of the trap. First place a bucket under this trap. With a cloth-covered stick clean out the trap and flush it into the bucket.

Before a plumbing system is used, it should be inspected to see that all the joints are tight. There is a municipal inspector in the cities and large towns, but the inhabitants of small towns must be their own building inspectors or rely upon the plumber's test. The following method may be used in testing plumbing:

The Peppermint Test. Without taking it into the house, pour two ounces of peppermint down the soil pipe through its opening on the roof. Then pour down a pail of hot water. If the seals are perfect and any odor of peppermint is detected in the house, the joints must be defective. The person using the peppermint should not go into the house until the test is over for fear of carrying the odor.

Note to Teacher. Ask your plumber for a catalog of fixtures, Have the students point out good and bad points in their design.

CHAPTER XXXVIII

SEWAGE AND GARBAGE DISPOSAL

All of the waste from animal bodies, food waste, and the dead plant and animal bodies must be made fit for plant food again in order to be harmless. If it were not for the bacteria in the soil this could not be accomplished except by burning. These bacteria are found most abundant in the first two feet of loamy soil. They do not flourish in water-soaked soil, for in this they are deprived of air. Manure to be used as a fertilizer must be worked over by these bacteria before the ground is enriched in plant food.

When the water from sewage is so acted upon there is no danger if it gets into the drinking water supply. A system of filter beds for the sewage is used by many towns and cities, and an analysis of the water as it leaves the filter beds shows that it is free from any disease-producing bacteria and any odor or taste. Filter beds are made as follows:

A large area from 10 to 12 feet deep, with a cement bottom and sides, has placed upon it:

1. A row of drain pipes.
2. A layer of coarse gravel.
3. A layer of fine gravel.

4. A layer of coarse sand.
5. A layer of fine sand from 3 to 5 feet deep.

The sewage is received in a settling tank where the papers are allowed to settle and all of the solid material to be disintegrated by water and decomposition. A certain amount of sewage is then allowed to flow on to the filter bed, and after this has drained through the sand, some time is allowed before more sewage is applied. As the water drains through, the bacteria in the sand make it free from harmful chemical products as well as from bacteria; they do not allow disease bacteria to live. It was once thought that the purifying action was due to the filtering alone, but when sand was used which had been heated to free it from the soil bacteria, the water was much less pure.

Such filter beds in use in Lawrence, Mass., London, and Hamburg have become famous for the results they have produced in preventing typhoid and cholera epidemics. Drinking water from rivers and small streams is often purified by this method.

This same method should be applied to the sewage of the isolated farm house or the village. A tank should hold the sewage until large insoluble material has settled or become finely divided. Then a pipe should carry the sewage to fields provided with troughs between ridges upon which crops of hay or grain are raised, not fruits or vegetables. It is then used as irrigating water. A village should, of course, have a filter bed. The pipe which carries the sewage from the settling tank should not leach into clayey soil, but should be carried in the loamy soil where most of the bacteria are, so that the leakages will be made harmless. The settling tank is called a cesspool. It should be made of brick or stone and cemented so as to prevent contamination of the surrounding soil.

If privies are used instead of a sewerage system, they

should be provided with boxes or buckets which should be emptied very frequently and their contents buried in light, loamy soil. The material should be raked over to disintegrate it before it is covered with soil. Soil should cover the contents of the boxes at all times, and fresh lime may be added as a disinfectant.

No sewage should be so carelessly looked after that there is any chance of its giving infection by means of flies or other insects, or through the water supply.

Garbage, while fresh, may be fed to swine or poultry. It may also be burned or buried lightly and decomposed by the soil bacteria. It should not be exposed so as to be a feeding place for flies.

CHAPTER XXXIX

WATER SUPPLY

The sources of water supply are as follows:

1. Dug wells.
2. Springs.
3. Artesian wells, bored or driven.
4. Rivers.
5. Large lakes.
6. Mountain streams.

Of all these, artesian wells are safest. All surface waters are liable to contamination by washings car-

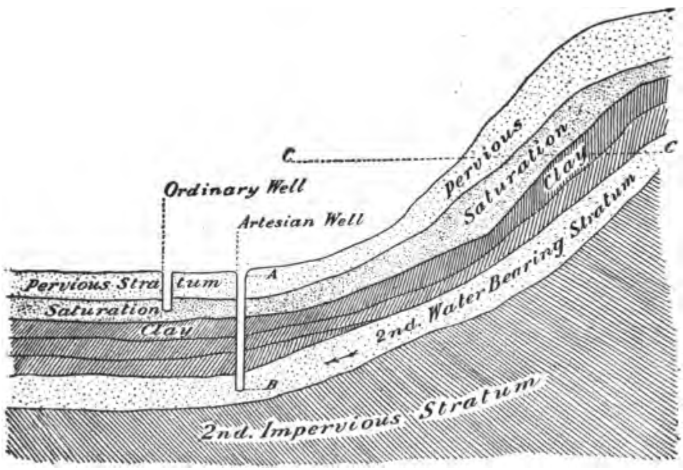


Fig. 15.—Geological formation favorable to the obtaining of water by means of artesian wells. (After Harrington.)

ried into them from the surrounding land. The water of dug wells may be contaminated or not,

depending upon whether the water-bearing stratum is reached by the water from a leaching cesspool, stable, privy, or the waste poured on the soil above

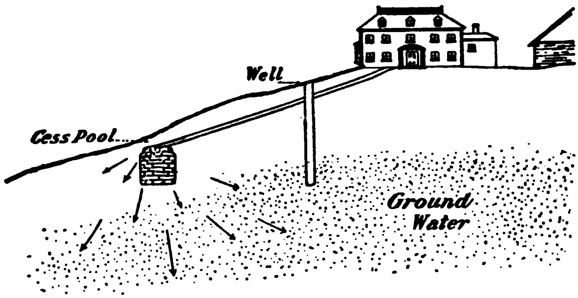


Fig. 16.—How a well located on high ground may be polluted by the contents of a cesspool lower down. (After Harrington.)

it. Since these possibilities are difficult to prevent, dug wells should not be used. An example has already been given of how an epidemic of typhoid

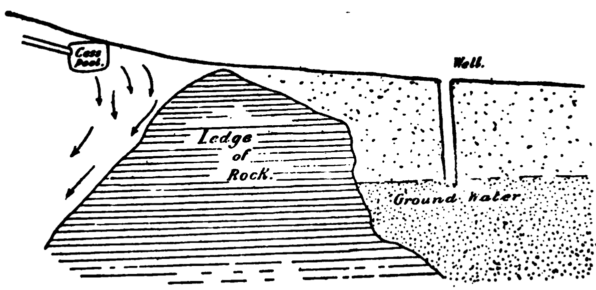


Fig. 17.—How a cesspool located on high ground may fail to pollute a well lower down. (After Harrington.)

was produced by spring water contaminated some miles away.

If dug wells are used, the walls and the top should

be cemented to prevent the flowing in of any water thrown on the surface near them.

The only house filter that is not worse than none is the Pasteur-Chamberland, or others built on that principle. This consists of a baked clay tube with a small bore in its center, opening at one end, and a metal tube in which this earthen tube is contained. The pressure forces the water through the clay into the small bore from the opening of which it flows into a receptacle used for storing it until it is ready to be cooled. To keep the filter in good condition, the clay tube should be washed daily and baked every week when the water leaves a deposit of any thickness.

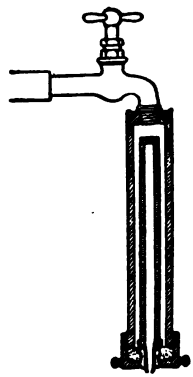


Fig. 18.—Chamberland-Pasteur filter.

CHAPTER XL

CLEAN FOOD

The problem of clean food is to be solved by the control of human excretions and of insects, chiefly the common house fly.

1. **Flies.** Flies carry germs not only on their wings and feet, but also in their intestines, from which they may be deposited anywhere. Typhoid and tuberculosis bacteria found in fly specks have produced these diseases in from 9 to 15 days after they were given off by the fly.

2. **Dust.** If one stops to think of what dust is composed—soil, manure, dried sputum, bits of animal skin and hair and excretions, bacteria, molds, and yeasts—he will instantly understand how dangerous it may be. Fortunately, disease-producing bacteria do not multiply outside the body, nor do they survive the dryness and light of out-of-door air. Typhoid, tuberculosis, boils, abscesses, and carbuncles have the most resistant kinds of bacteria. Spitting and the depositing of other infected material where insects can get at it, or where the germs in it may be blown into dust before they are dead, cause many cases of disease.

When mosquito netting is laid over fruits and

vegetables so closely that insects may contaminate at least the top layer, the netting is practically useless. If screening is used, dust contamination is still possible. Glass cases should be used for displaying food. Food should likewise be protected from house dust, which is likely to contain, among other things, droplets from coughing, etc.

3. **The Handling of Food.** In stores and like places, all food which may be eaten raw or would be difficult to clean should be kept covered. Utensils, rather than the hands, should be used for handling supplies, and these utensils should be clean. The aprons and tables should be kept clean. The boy who handles the horses should not handle the food. For this reason it should be wrapped carefully when sent out of the store. The placing of candies, pretzels, and other foods on stands on the street should be strictly prohibited.

Any person who comes in contact with food in its distribution or preparation should be examined to see that he is free from typhoid, tuberculosis, social diseases, or serious skin troubles. This applies to the man who milks the cow and to the cook in the kitchen.

4. **The Eating of Raw Fruits and Vegetables.** Many cases of typhoid have been traced to sewage

REFERENCES. "Care of Food in the Home." Farmers' Bulletin 375, 1910, U. S. Dept. of Agriculture. Bureau of Entomology Bulletin 78.

contamination by way of water-cress, celery, lettuce, and radishes. These may carry germs of other intestinal disorders. This necessitates a very thorough washing of all such vegetables, and regulations to prohibit the flowing of sewage elsewhere than in irrigating ditches in such gardens. Fruits should be thoroughly washed, even though they are to be pared, on account of spraying to protect them from insects, and of the handling by orchard men and distributers.

CHAPTER XLI

LABOR SAVING AND DUST PREVENTION

Dirt is generally accompanied by germs. When it is dried and becomes dust, many of the germs die, but not all. Fortunately, disease germs, except those of tuberculosis, typhoid, and boils and carbuncles, do not survive long in dust. For health as well as for appearance, we like to keep ourselves and our belongings as free from dust as possible. But we recognize that most of the dust in our houses is comparatively harmless. The housekeeper may injure her health in excessive zeal in keeping a house dustless. The trouble lies chiefly in the amount of furniture and its design, the kind of woodwork, draperies, and heating appliances, together with poor methods of cleaning. The application of the following principles will remove many of these difficulties:

1. Have the furniture, woodwork, radiators, and walls of as simple design as possible, with smooth surfaces easily wiped off.
2. Avoid cracks in floors, woodwork, floor coverings, and utensils.
3. Avoid heavy draperies and cloth upholstered furniture as far as possible, unless a vacuum cleaner may be used.

4. Use a cloth moistened with furniture polish or with water and then wrung very dry for dusting. The dust cloth should not be so large that it can not be kept in the hand to prevent trailing about and distributing dust again. When sweeping is done, the windows and doors should be closed and left for at least two hours before dusting, so that all of the dust which was driven into the air may have time to settle upon some surface from which it may be removed with the damp dusting cloth. Many housekeepers wonder where the dust comes from when they see it on the furniture directly after they have finished dusting. How can this be explained? The only satisfactory method of removing dust from the house is by actually taking it away from the house and from the air. Shaking a dust or mop cloth out of the window simply scatters the dust to other places nearby, if it does not come into the same house again. Dust cloths and mops should be washed out frequently during dusting and mopping and at the end of these processes; then the dust is carried off in the sewer. If a vacuum cleaner is used, the dust which it collects should not be thrown into the back yard or the alley; it should be burned.

CHAPTER XLII

DISINFECTANTS

A disinfectant is a substance which will kill germs. Among those most commonly used for different purposes are the following:

1. *For hands, face, and skin.* When a disinfectant must be used for some time upon the patient, or upon the hands of the nurse after every handling of the patient or his utensils, mercuric chloride, called corrosive sublimate, is good. Carbolic acid and formalin are effective disinfectants but they have a bad effect on the skin. For all but surgical work, it is sufficient to scrub the hands with sand soap and then immerse them in a corrosive sublimate solution, one part to one thousand of water as hot as the hands can stand.

2. *For mucous surfaces,* a saturated solution of boric acid is best.

3. *For wounds.* Hydrogen peroxide is antiseptic in as weak a solution as one part in twenty thousand of water. Carbolic acid (one part in twenty of water) or corrosive sublimate (one part in five hundred or one thousand) will be found excellent disinfectants. Living germs are killed in a few minutes in this solution of corrosive sublimate. Spores are killed in less than one hour.

4. *Bathroom closet fixtures.* Either lye or acid may be used inside the closet bowl, and formalin, one part to twenty of water, may be used to wash the outside of the bowl and the floor.

5. *Light bedding and clothing.* These should be soaked

in corrosive sublimate (1:1000) or carbolic acid (1:20) before they are washed. Then they should be boiled for an hour.

6. *Heavy bedding and clothing and carpets.* These should be disinfected in a special steam apparatus. The benzine process of cleaning does not destroy all germs.

7. *Books and furniture.* Books should be treated with formaldehyde gas when standing with their leaves as much separated as possible. It is well to repeat the process several times. Inexpensive books should be burned if they are infected. Stuffed furniture should be well beaten and exposed a long time in the air and direct sunlight. Wooden or leather-covered furniture should be thoroughly wiped with corrosive sublimate solution or with formalin (1:20).

8. *Excreta.* Excreta should be received in a vessel containing a greater volume of disinfectant than there should be excreta. The best disinfectant which is the least offensive in odor or appearance in formalin (1:20). The disinfectant should be thoroughly mixed with the excreta and stand covered for one hour before being disposed of. In out-of-doors closets fresh lime should be sprinkled over the contents of the receiving box at least once a day. Earth closets are also sanitary means of preventing the carrying out of infectious material by insects.

9. *For ordinary scrubbing or washing.* For these purposes water feeling hot to the hands, in which ½ tablespoon of washing soda for each quart of water has been dissolved, is effective.

Formerly emphasis was laid upon fumigation of rooms as the method of preventing new cases of a disease. Experiments show that sulphur is a disinfectant only when it is burned in a room into which live steam is also being poured. It is absolutely useless without a great supply of water. Formaldehyde, while probably more effective than sulphur,

yet leaves live germs after it has been used with great care. This sort of disinfection has produced a false sense of safety. In Providence, Rhode Island, for some years there has been no disinfection after scarlet fever and diphtheria. The results in the number of new cases show that disinfection had no appreciable value. The patients, missed cases, and carriers are far more dangerous than furniture, clothing, and air. If the precautions spoken of before to disinfect the excreta are taken, the greatest source of danger removed.

The direct rays of the sun have great disinfecting powers. Diffused daylight generally retards the growth of micro-organisms, although not always. The direct rays act on germs somewhat as they do on human flesh, producing sunburns. Typhoid and tuberculosis germs exposed to the sun are killed in a few minutes, if they are not in sputum or solid material. In sputum, from twenty to thirty hours are required. Direct sunlight is not to be obtained in rooms over any great space for a considerable length of time. Consequently the sunlight in rooms is more for cheerfulness and light than for disinfecting purposes. Direct sunlight is not a disinfectant when it passes through window glass. The violet and ultra-violet rays are the most effective for sterilizing, and they do not pass through glass.

REFERENCES. *Practical Hygiene*, Harrington. *Sources and Modes of Infection*, Chapin. *Household Bacteriology*, Buchanan.

APPENDIX

TABLE I

Food		Protein Per Cent	Fat Per Cent	Carbohydrate Per Cent	Fuel Value Per Pound Calories	Ash	Water
Almonds	Edible Portion	21.0	54.9	17.3	2940	2.0	4.8
	As Purchased	11.5	30.2	9.5	1615	1.1	2.7
Apples	E. P.	.4	.5	14.2	285	.3	84.6
	A. P.	.3	.3	10.8	214	.3	63.3
Apricots	E. P.	1.1	....	13.4	263	.5	85.0
	A. P.	1.0	....	12.6	247	.5	79.9
Apricots, dried	A. P.	4.7	1.0	62.5	1256	2.4	29.4
Artichokes	A. P.	2.6	.2	16.7	357	1.0	79.5
Asparagus, fresh	A. P.	1.8	.2	3.3	100	.7	94.0
cooked	A. P.	2.1	3.3	2.2	213	.8	91.6
Bacon, smoked	E. P.	10.5	64.8	....	2840	4.5	20.2
	A. P.	9.5	59.4	....	2372	2.2	18.4
Bananas	E. P.	1.3	.6	22.0	447	.8	75.3
	A. P.	.8	.4	14.3	290	.6	48.9
Barley, pearled		8.5	1.1	77.8	1615	1.1	11.5
Beans, dried		22.5	1.8	59.6	1565	3.5	12.6
lima, dried		18.1	1.5	65.9	1586	4.1	10.4
lima, fresh	E. P.	7.1	.7	22.0	557	1.7	68.5
	A. P.	3.2	.3	9.9	250	.8	30.8
string, fresh	E. P.	2.3	.3	7.4	184	.8	89.2
	A. P.	2.1	.3	6.9	176	.7	83.0
baked, canned	A. P.	6.9	2.5	19.6	583	2.1	68.9
string, canned	A. P.	1.1	.1	3.8	93	1.3	93.7
lima, canned	A. P.	4.0	.3	14.6	350	1.6	79.5
Beef brisket, medium fat	E. P.	15.8	28.5	....	1449	.9	54.6
	A. P.	12.0	22.3	....	1130	.6	41.6
chuck, average	E. P.	19.2	15.4	....	978	.9	68.3
	A. P.	15.8	12.5	....	797	.8	57.9
corned, average	E. P.	15.6	26.2	....	1353	4.9	53.6
	A. P.	14.3	23.8	....	1230	4.6	49.2
dried, salted, and sm'kd	E. P.	30.0	6.5	.4	817	9.1	54.3
	A. P.	26.4	6.9	....	724	8.9	53.7

TABLE I, *continued*

Food		Protein Per Cent	Fat Per Cent	Carbohydrate Per Cent	Fuel Value Per Pound Calories	Ash	Water
Beef flank, lean	E. P.	20.8	11.3	....	838	1.0	67.8
	A. P.	20.5	11.0	....	821	1.0	66.9
fore shank, lean	E. P.	22.0	6.1	....	647	1.0	71.5
	A. P.	14.0	3.9	....	414	.6	45.4
heart	E. P.	16.0	20.4	1.0	1140	1.0	62.6
	A. P.	14.8	24.7	.9	1292	.9	53.2
hind shank, lean	E. P.	21.9	5.4	....	617	1.0	72.5
	A. P.	9.1	2.2	....	255	.4	30.1
hind shank, fat	E. P.	20.4	18.8	....	1171	.9	61.4
	A. P.	9.9	9.1	....	552	.4	29.7
liver	E. P.	20.4	4.5	1.7	584	1.6	71.2
	A. P.	20.2	3.1	2.5	537	1.3	65.6
loin	E. P.	19.7	12.7	....	877	1.0	61.3
	A. P.	17.1	11.1	....	764	.9	52.9
neck, lean	E. P.	21.4	8.4	....	732	1.0	70.1
	A.P.	15.1	5.9	....	493	.7	49.5
neck, medium fat	E. P.	20.1	16.5	....	1040	.9	63.4
	A. P.	14.5	11.9	....	749	.7	45.9
plate, lean	E. P.	15.6	18.8	....	1051	.7	65.9
	A. P.	13.0	15.5	....	867	.6	54.4
porterhouse steak	E. P.	21.9	20.4	....	1230	1.0	60.0
	A. P.	19.1	17.9	....	1077	.8	52.4
rib rolls, lean	A. P.	20.2	10.5	....	795	1.0	69.0
ribs, lean	E. P.	19.6	12.0	....	845	1.0	67.9
	A. P.	15.2	9.3	....	654	.7	52.6
ribs, fat	E. P.	15.0	35.6	....	1721	.7	48.5
	A. P.	12.7	30.6	....	1480	.6	39.6
roast	A. P.	22.3	28.6	....	1576	1.3	48.2
round, lean	E. P.	21.3	7.9	....	694	1.1	70.0
	A. P.	19.5	7.3	....	649	1.0	64.4
round, free from visible fat.		23.2	2.5	....	512	1.2	73.5
rump, lean	E. P.	20.9	13.7	....	940	1.0	65.7
	A. P.	19.1	11.0	....	796	.9	56.6
rump, fat	E. P.	16.8	35.7	....	1763	.8	47.1
	A. P.	12.9	27.6	....	1361	.6	36.2
sirloin steak	E. P.	18.9	18.5	....	1099	1.0	61.9

TABLE I, *continued*

Food		Protein Per Cent	Fat Per Cent	Carbohydrate Per Cent	Fuel Value Per Pound Calories	Ash	Water
Beef Juice		4.9	.6	....	89	1.5	93.0
	A. P.	16.5	16.1	....	960	.9	54.0
Beef Suet		4.7	81.8	....	3357	.2	13.7
sweetbreads	A. P.	16.8	12.1	....	799	2.0	69.0
tenderloin	A. P.	16.2	24.4	....	1290	.8	59.2
tongue	E. P.	18.9	9.2	....	717	1.0	70.8
	A. P.	14.1	6.7	....	529	.8	51.8
Beets, cooked	E. P.	2.3	.1	7.4	180	1.6	88.6
fresh	E. P.	1.6	.1	9.7	209	1.1	87.5
	A. P.	1.3	.1	7.7	167	.9	70.0
Blackberries	A. P.	1.3	1.0	10.9	262	.5	86.3
Bluefish	E. P.	19.4	1.2	....	402	1.3	78.5
	A. P.	10.0	.6	....	206	.7	40.3
Boston crackers		11.0	8.5	71.1	1835	1.9	7.5
Brazil nuts	E. P.	17.0	66.8	7.0	3040	3.9	5.3
	A. P.	8.6	33.7	3.5	1591	2.0	2.6
Bread, graham		8.9	1.8	52.1	1189	1.5	35.7
rolls, water		9.0	3.0	54.2	1268	1.2	32.6
toasted		11.5	1.6	61.2	1385	1.7	24.0
white, homemade		9.1	1.6	53.3	1199	1.0	35.0
milk		9.6	1.4	51.1	1158	1.4	36.5
vienna		9.4	1.2	54.1	1199	1.1	34.2
average		9.2	1.3	53.1	1182	1.1	35.3
whole wheat		9.7	.9	49.7	1113	1.3	38.4
Buckwheat flour		6.4	1.2	77.9	1580	.9	13.6
Butter		1.0	85.0	....	3491	3.0	11.0
Buttermilk		3.0	.5	4.8	162	.7	91.0
Butternuts	E. P.	27.9	61.2	3.5	3065	2.9	4.4
Butternuts	A. P.	3.8	8.3	.5	417	.4	.6
Cabbage	E. P.	1.6	.3	5.6	143	1.0	91.5
	A. P.	1.4	.2	4.8	121	.9	77.7
Calf's-foot jelly		4.3	....	17.4	394	.7	77.6
Carrots, fresh	E. P.	1.1	.4	9.3	204	1.0	88.2
	A. P.	.9	.2	7.4	158	.9	70.6
Cauliflower	A. P.	1.8	.5	4.7	139	.7	92.3

TABLE I, *continued*

Food		Protein Per Cent	Fat Per Cent	Carbohydrate Per Cent	Fuel Value Per Pound Calories	Ash	Water
Celery	E. P.	1.1	.1	3.3	840	1.0	94.5
	A. P.	.9	.1	2.6	676	.8	75.6
Celery soup, canned		2.1	2.8	5.0	243	1.5	88.6
Cerealine		9.6	1.1	78.3	1640	.7	10.3
Cheese, American pale		28.8	35.9	.3	1990	3.4	31.6
American red		29.6	38.3	....	2102	3.5	28.6
Cheddar		27.7	36.8	4.1	2080	4.0	27.4
Cottage		20.9	1.0	4.3	499	1.8	72.0
Full cream		25.9	33.7	2.4	1890	3.8	34.2
Fromage de Brie		15.9	21.0	1.4	1170	1.5	60.2
Neuchatel		18.7	27.4	1.5	1484	2.4	50.0
Pineapple		29.9	38.9	2.6	2180	5.6	23.0
Roquefort		22.6	29.5	1.8	1645	6.8	39.3
Swiss		27.6	34.9	1.3	1945	4.8	31.4
Cherries, fresh	E. P.	1.0	.8	16.7	354	.6	80.9
	A. P.	.9	.8	15.9	337	.6	76.8
canned	A. P.	1.1	.1	21.1	407	.5	77.2
Chestnuts, fresh	E. P.	6.2	5.4	42.1	1098	1.3	45.0
	A. P.	5.2	4.5	35.4	920	1.1	37.8
Chicken, broilers	E. P.	21.5	2.5	....	493	1.1	74.8
	A. P.	12.8	1.4	....	289	.7	43.7
Chocolate		12.9	48.7	30.3	2768	2.2	5.9
Cocoa		21.6	28.9	37.7	2258	7.2	4.6
Cocoanut (prepared)		6.3	57.4	31.5	2980	1.3	3.5
Cod, dressed	A. P.	11.1	.2	....	209	.8	58.5
salt	E. P.	25.4	.3	....	473	24.7	53.5
	A. P.	19.0	.4	....	361	18.5	40.2
Consommé, canned	A. P.	2.5	....	.4	53	1.1	96.0
Corn, green	A. P.	2.8	1.2	19.0	455	.3	29.4
Corn meal		9.2	1.9	75.4	1620	1.0	12.5
Cornstarch		....	....	90.0	1629.	...	....
Cottolene		....	100.0	....	4000	...	....
Crackers, butter	A. P.	9.6	10.1	71.6	1887	1.5	7.2
cream	A. P.	9.7	12.1	69.7	1938	1.7	6.8
graham	A. P.	10.0	9.4	73.8	1905	1.4	5.4

TABLE I, *continued*

Food		Protein Per Cent	Fat Per Cent	Carbohydrate Per Cent	Fuel Value Per Pound Calories	Ash	Water
Crackers, soda	A. P.	9.8	9.1	73.1	1875	2.1	5.9
water	A. P.	10.7	8.8	71.9	1855	1.8	6.8
Cranberries	A. P.	.4	.6	9.9	212	.2	8.9
Cream		2.5	18.5	4.5	883	.5	74.0
Cucumbers	E. P.	.8	.2	3.1	79	.5	95.4
	A. P.	.7	.2	2.6	68	.4	81.1
Currants, fresh		1.5	....	12.8	259	.7	85.0
dried Zante		2.4	1.7	74.2	1455	4.5	17.2
Dates, dried	E. P.	2.1	2.8	78.4	1575	1.3	15.4
	A. P.	1.9	2.5	70.6	1430	1.2	13.8
Doughnuts		6.7	21.0	53.1	1941	.9	18.3
Eggplant	E. P.	1.2	.3	5.1	126	.5	92.9
Eggs, uncooked	E. P.	13.4	10.5	....	672	1.0	73.7
	A. P.	11.9	9.3	....	594	.9	65.5
Farina		11.0	1.4	76.3	1640	.4	10.9
Figs, dried		4.3	.3	74.2	1437	2.4	18.8
Flounder	A. P.	5.4	.3	....	110	5.0	61.5
Flounder	E. P.	14.2	.6	....	282	1.3	84.2
Flour, rye		6.8	.9	78.7	1590	.7	12.9
wheat, California fine		7.9	1.4	76.4	1585	.5	13.8
wheat, entire		13.8	1.9	71.9	1630	1.0	11.4
wheat, graham		13.3	2.2	71.4	1628	1.8	11.3
wheat, patent roller process[1]		13.3	1.5	72.7	1623	.6	11.9
wheat, straight grade		10.8	1.1	74.8	1608	.5	12.8
Fowls	E. P.	19.3	16.3	....	1017	1.0	63.7
	A. P.	13.7	12.3	....	752	.7	47.1
Gelatin		91.4	.1	....	1660	2.1	13.6
Grape butter		1.2	.1	58.5	1088	3.5	36.7
Grapes	E. P.	1.3	1.6	19.2	437	.5	77.4
	A. P.	1.0	1.2	14.4	328	.4	58.0
Haddock	E. P.	17.2	.3	....	324	1.2	81.7
	A. P.	8.4	.2	....	160	.6	40.0
Halibut steaks	E. P.	18.6	5.2	....	550	1.0	75.4
	A. P.	15.3	4.4	....	457	.9	61.9

[1]Baker's grade.

TABLE I, *continued*

Food		Protein Per Cent	Fat Per Cent	Carbohydrate Per Cent	Fuel Value Per Pound Calories	Ash	Water
Ham, fresh, lean	E. P.	25.0	14.4	....	1042	1.3	60.0
	A. P.	24.8	14.2	....	1030	1.3	59.4
fresh, medium	E. P.	15.3	28.9	....	1458	.8	53.9
	A. P.	13.5	25.9	....	1303	.8	48.0
smoked, lean	E. P.	19.8	20.8	....	1209	5.5	53.5
	A. P.	17.5	18.5	....	1073	4.9	47.2
Herring, whole	E. P.	19.5	7.1	....	644	1.5	72.5
	A. P.	11.2	3.9	....	362	.9	41.7
Herring, smoked	E. P.	36.9	15.8	....	1315	13.2	34.6
	A. P.	20.5	8.8	....	731	7.4	19.2
Hominy		8.3	.6	79.0	1609	.3	11.8
Honey		.4	....	81.2	1481	.2	18.2
Huckleberries		.6	.6	16.6	336	.3	81.9
Koumiss		2.8	2.1	5.4	234	.4	89.3
Lamb, breast	E. P.	19.1	23.6	....	1311	1.0	56.2
	A. P.	15.4	19.1	....	1058	.8	45.5
chops, broiled	E. P.	21.7	29.9	....	1614	1.3	47.6
fore quarter	E. P.	18.3	25.8	....	1385	1.0	55.1
	A. P.	14.9	21.0	....	1127	.8	44.7
hind quarter	E. P.	19.6	19.1	....	1149	1.0	60.9
	A. P.	16.5	16.1	....	953	.9	51.3
leg, roast		19.7	12.7	....	876	.8	67.1
side	E. P.	17.6	23.1	....	1263	1.1	46.1
	A. P.	14.1	18.7	....	1015	.8	47.0
Lard, refined		....	100.0	....	4086	...	....
Lemon juice		....	....	9.8	178	...	....
Lemons	E. P.	1.0	.7	8.5	201	.5	89.3
	A. P.	.7	.5	5.9	140	.4	62.5
Lettuce	E. P.	1.2	.3	2.9	87	.9	94.7
	A. P.	1.0	.2	2.5	72	.8	80.5
Liver, beef	E. P.	20.4	4.5	1.7	583	1.6	71.2
	A. P.	20.2	3.1	2.5	538	1.3	65.6
veal	E. P.	19.0	5.3	....	562	1.3	73.0
Lobster, whole	E. P.	16.4	1.8	.4	379	2.2	79.2
	A. P.	5.9	.7	.2	139	.8	30.7
canned	A. P.	18.1	1.1	.5	382	2.5	77.8

TABLE I, *continued*

Food		Protein Per Cent	Fat Per Cent	Carbohydrate Per Cent	Fuel Value Per Pound Calories	Ash	Water
Macaroni		13.4	.9	74.1	1625	1.3	10.3
Macaroons		6.5	15.2	65.2	1922	.8	12.3
Mackerel	E. P.	18.7	7.1	....	629	1.2	73.4
	A. P.	10.2	4.2	....	356	.7	40.4
salt	E. P.	21.1	22.6	....	1305	13.2	42.2
	A. P.	16.3	17.4	....	1005	10.2	32.5
Marmalade, orange		.6	.1	84.5	1548	.3	14.5
Milk, condensed, sweetened		8.8	8.3	54.1	1480	1.9	26.9
skimmed		3.4	.3	5.1	167	.7	90.5
whole		3.3	4.0	5.0	314	.7	87.0
Mincemeat, commercial		6.7	1.4	60.2	1280	4.0	27.7
homemade		4.8	6.7	32.1	942	2.0	54.4
Molasses, cane		2.4	....	69.3	1302	3.2	25.1
Mushrooms	A. P.	3.5	.4	6.8	204	1.2	88.1
Muskmelons	E. P.	.6	....	9.3	180	.6	89.5
	A. P.	.3	....	4.6	89	.3	44.8
Mutton, fore quarter	E. P.	15.6	30.9	....	1543	.9	52.9
	A. P.	12.3	24.5	....	1223	.7	41.6
hind quarter	E. P.	16.7	28.1	....	1450	.8	54.8
	A. P.	13.8	23.2	....	1197	.7	45.4
leg	E. P.	19.8	12.4	....	863	1.1	67.4
	A. P.	16.5	10.3	....	718	.9	56.1
side	A. P.	13.0	24.0	....	1215	.7	13.0
	E. P.	16.2	29.8	....	1512	.9	16.3
Nectarines	E. P.	.6	....	15.9	299	.6	82.9
	A. P.	.6	....	14.8	280	.6	77.4
Oatmeal		16.1	7.2	67.5	1811	1.9	7.3
Okra	E. P.	1.6	.2	7.4	172	.6	90.2
	A. P.	1.4	.2	6.5	152	.5	78.9
Olives, green	E. P.	1.1	27.6	11.6	1357	1.7	58.0
Olives	A. P.	.8	20.2	8.5	995	1.2	42.3
ripe	E. P.	1.7	25.0	4.3	1130	3.4	64.7
	A. P.	1.4	21.0	3.5	947	2.7	52.4
Onions, fresh	E. P.	1.6	.3	9.9	220	.6	87.6
	A. P.	1.4	.3	8.9	199	.5	78.9

TABLE I, *continued*

Food		Protein Per Cent	Fat Per Cent	Carbohydrate Per Cent	Fuel Value Per Pound Calories	Ash	Water
Oranges	E. P.	.8	.2	11.6	233	.5	86.9
	A. P.	.6	.1	8.5	169	.4	63.4
Oxtail soup, canned	A. P.	3.8	.5	4.2	166	1.9	87.8
Oysters	E. P.	6.2	1.2	3.7	228	2.0	86.9
in shell	A. P.	1.2	.2	.7	43	4.0	16.1
canned	A. P.	8.8	2.4	3.9	328	1.5	83.4
Parsnips	E. P.	1.6	.5	13.5	294	1.4	83.0
	A. P.	1.3	.4	10.8	236	1.1	66.4
Pea soup, canned	A. P.	3.6	.7	7.6	232	1.2	86.9
Peaches, canned	A. P.	.7	.1	10.8	213	.3	88.1
fresh	E. P.	.7	.1	9.4	188	.4	89.4
	A. P.	.5	.1	7.7	153	.3	73.3
Peanuts	E. P.	25.8	38.6	24.4	2490	2.0	9.2
	A. P.	19.5	29.1	18.5	1858	1.5	6.9
Peanut Butter		29.3	46.5	17.1	2690	5.0	2.1
Pears, fresh	E. P.	.6	.5	14.1	288	.4	84.4
	A. P.	.5	.4	12.7	245	.4	76.0
Peas, canned	A. P.	3.6	.2	9.8	252	1.1	85.3
dried		24.6	1.0	62.0	1611	2.9	9.5
green	E. P.	7.0	.5	16.9	454	1.0	74.6
	A. P.	3.6	.2	9.8	252	.6	40.8
Pies, apple		3.1	9.8	42.8	1233	1.8	42.5
custard		4.2	6.3	26.1	806	1.0	62.4
lemon		3.6	10.1	37.4	1156	1.5	47.4
mince		5.8	12.3	38.1	1300	2.5	41.3
squash		4.4	8.4	21.7	817	1.3	64.2
Pineapples, fresh	E. P.	.4	.3	9.7	196	.3	89.3
canned	A. P.	.4	.7	36.4	695	.7	61.8
Pignolias	E. P.	33.9	49.4	6.9	2748	3.4	6.4
Pistachios, shelled		22.3	54.0	16.3	2900	3.2	4.2
Plums	E. P.	1.0	....	20.1	383	.5	78.4
	A. P.	.9	....	19.1	363	.5	74.5
Pomegranates	E. P.	1.5	1.6	19.5	447	.6	76.8
Pork, chops, medium	E. P.	16.6	30.1	....	1530	1.0	52.0
	A. P.	13.4	24.2	....	1230	.8	41.8

TABLE I, *continued*

Food		Protein Per Cent	Fat Per Cent	Carbohydrate Per Cent	Fuel Value Per Pound Calories	Ash	Water
Pork, fat, salt	A. P.	1.9	86.2	....	3555	3.9	7.9
sausage	A. P.	13.0	44.2	1.1	2030	2.2	39.8
side	E. P.	9.1	55.3	....	2423	.5	34.4
	A. P.	8.0	49.0	....	2123	.5	30.4
tenderloin	A. P.	18.9	13.0	....	875	1.0	66.5
Potato chips	A. P.	6.8	39.8	46.7	2598	4.5	2.2
Potatoes, white, raw	E. P.	2.2	.1	18.4	378	1.0	78.3
	A. P.	1.8	.1	14.7	302	.8	62.6
sweet, raw	E. P.	1.8	.7	27.4	558	1.1	69.0
	A. P.	1.4	.6	21.9	447	.9	55.2
Prunes, dried	E. P.	2.1	....	73.3	1368	.6	79.6
	A. P.	1.8	....	62.2	1160	.5	75.6
Pumpkins	E. P.	1.0	.1	5.2	117	.6	93.1
	A. P.	.5	.1	2.6	60	.3	46.5
Radishes	E. P.	1.3	.1	5.8	133	.1	91.8
	A. P.	.9	.1	4.0	91	.7	64.3
Raisins	E. P.	2.6	3.3	76.1	1562	3.4	14.6
	A. P.	2.3	3.0	68.5	1407	3.1	13.1
Raspberries, red		1.0	....	12.6	247	.6	85.8
black		1.7	1.0	12.6	300	.6	84.1
Rhubarb	E. P.	.6	.7	3.6	105	.7	94.4
	A. P.	.4	.4	2.2	63	.4	56.6
Rice		8.0	.3	79.0	1620	.4	12.3
Salmon, dressed	A. P.	13.8	8.1	....	582	.8	41.8
whole	E. P.	22.0	12.8	....	923	1.4	64.6
	A. P.	15.3	8.9	....	642	.9	40.9
Sausage, bologna	E. P.	18.7	17.6	.3	1061	3.7	60.0
	A. P.	18.2	19.7	....	1135	3.8	55.2
farmer	E. P.	29.0	42.0	....	2240	7.6	23.2
	A. P.	27.9	40.4	....	2156	7.3	22.2
Shad, whole	E. P.	18.8	9.5	....	727	1.3	70.6
	A. P.	9.4	4.8	....	367	.7	35.2
roe		20.9	3.8	2.6	582	1.5	71.2
Shredded wheat		10.5	1.4	77.9	1600	2.1	8.1
Spinach, fresh	A. P.	2.1	.3	3.2	109	2.1	92.3

TABLE I, *continued*

Food		Protein Per Cent	Fat Per Cent	Carbohydrate Per Cent	Fuel Value Per Pound Calories	Ash	Water
Squash	E. P.	1.4	.5	9.0	209	.8	88.3
	A. P.	.7	.2	4.5	103	.4	44.2
Strawberries		1.0	.6	7.4	169	.6	90.4
Succotash, canned		3.6	1.0	18.6	444	.9	75.9
Sugar		....	....	100.0	1815	...	....
Tallow		....	100.0	....	4000	...	....
Tomatoes, fresh	A. P.	.9	.4	3.9	104	.5	94.3
canned	A. P.	1.2	.2	4.0	103	.6	94.0
Turkey	E. P.	21.1	22.9	....	1320	1.0	55.5
	A. P.	16.1	18.4	....	1042	.8	42.4
sandwich, canned		20.7	29.2	....	1568	2.7	47.4
Turnips	E. P.	1.3	.2	8.1	178	.8	89.6
	A. P.	.9	.1	5.7	124	.6	62.7
Veal, breast	E. P.	20.3	11.0	....	817	1.0	68.2
	A. P.	15.3	8.6	....	629	.8	51.3
cutlet	E. P.	20.3	7.7	....	683	1.1	70.7
	A. P.	20.1	7.5	....	670	1.0	68.3
fore quarter	E. P.	20.0	8.0	....	690	.9	71.7
	A. P.	15.1	6.0	....	517	.7	54.2
hind quarter	E. P.	20.7	8.3	....	715	1.0	70.9
	A. P.	16.2	6.6	....	534	.8	56.2
Vegetable soup, canned		2.9	....	.5	62	.9	95.7
Walnuts, California	E. P.	18.4	64.4	13.0	3182	1.7	2.5
black	E. P.	27.6	56.3	11.7	3001	1.9	2.5
Watermelons	E. P.	.4	.2	6.7	136	.3	92.4
Wheat, cracked		11.1	1.7	75.5	1635	1.6	10.1
Whitefish	E. P.	22.9	6.5	....	680	1.6	69.8
	A. P.	10.6	3.0	....	315	.7	32.5
Zwiebach		9.8	9.9	73.5	1915	1.0	5.8

EDIBLE ORGANIC NUTRIENTS AND FUEL VALUES OF FOODS [1]

[1] The percentages of nutrients are taken from Bull. 28, Office of Experiment Stations, U. S. Department of Agriculture. The fuel values are calculated from these percentages by the use of the factors explained in Chapter I, viz.—protein, 4 calories; fat, 9 calories; carbohydrate, 4 calories per gram.

Plate 34—Regular Porter-house Steak

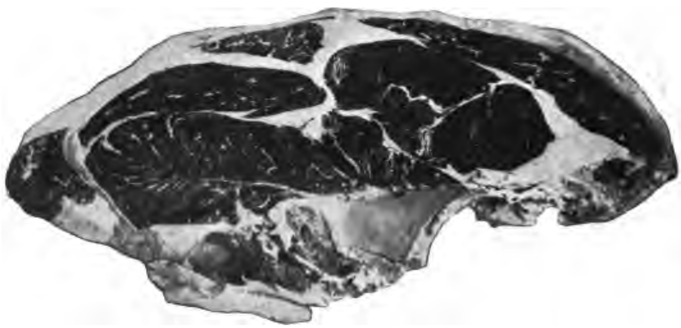


Plate 35—Butt-end Sirloin Steak

Plate 36—Hip-bone Sirloin Steak


Plate 37—Chuck Steak

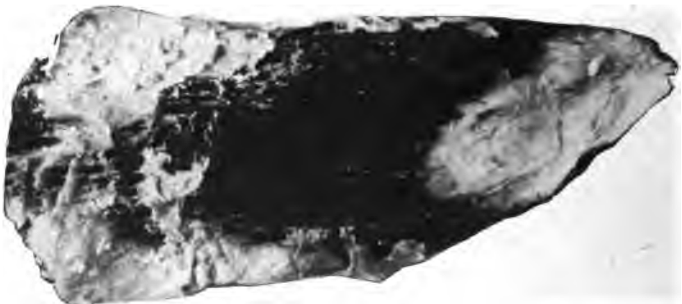


Plate 38—Flank Steak

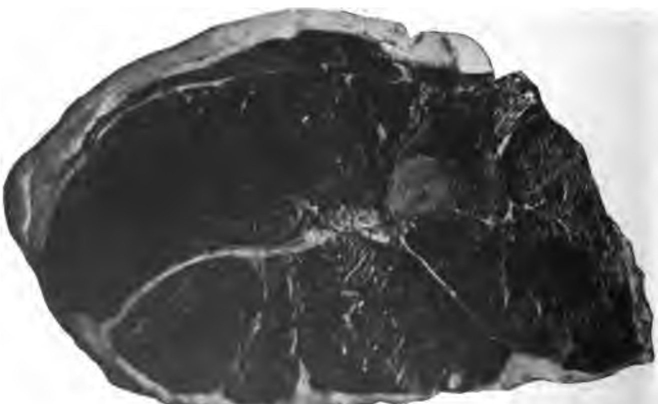


Plate 39—Round Steak

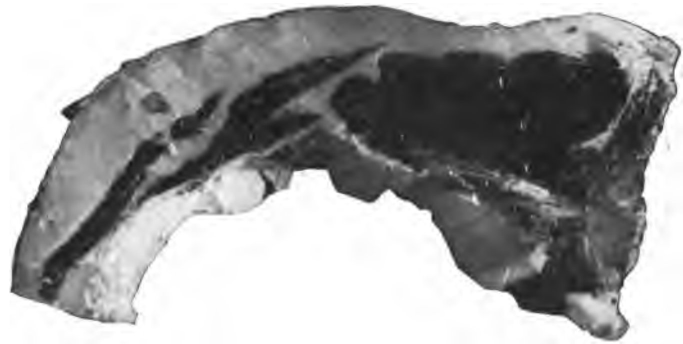


Plate 40—Club Steak

Plate 41—Chuck Steak

Plate 42—Hip-bone Porter-house Steak

Plate 43—Round-bone Sirloin Steak

Plate 44—6th Rib Roast

Plate 45—7th and 8th Rib Roast

Plate 46—9th and 10th Rib Roast

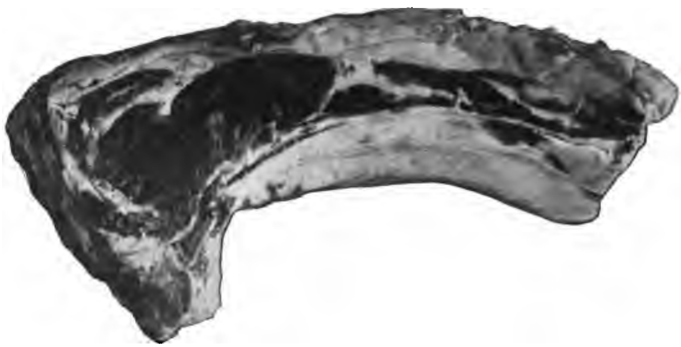


Plate 47—11th and 12th Rib Roast

Plate 48—Chuck Rib Roast

Plate 49—Rump Roast

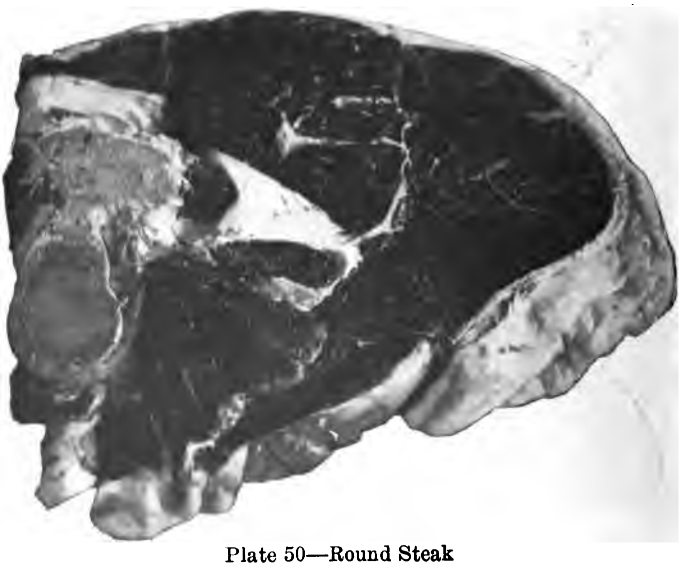


Plate 50—Round Steak


Plate 51—Round Pot Roast


Plate 52—Shoulder Pot Roast

Plate 53—Shoulder Pot Roast

Plate 54—Shoulder Pot Roast

Plate 55—Chuck Stew

Plate 56—Knuckle Soup Bone

Plate 57—Knuckle Soup Bone

Plate 58—Hind Shank Soup Bone

Plate 59—Neck

Plate 60—Flank Stew

Plate 61—Foreshank Soup Bones

Plate 62—Brisket

Plate 63—Shoulder Clod

Plate 64—Navel

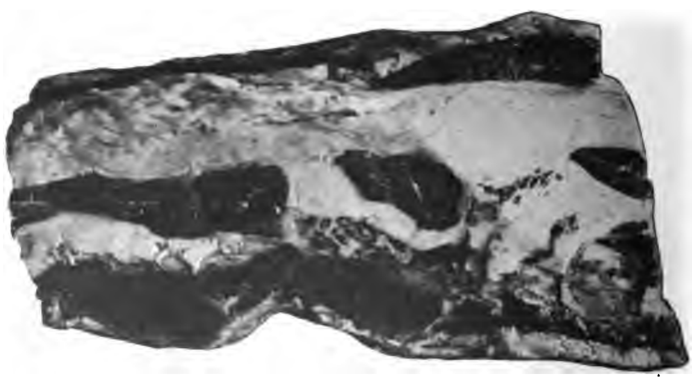


Plate 65—Rib Ends

INDEX